

Stuart Otteson

The Bolt Action

Volume II

The Bolt Action

A DESIGN ANALYSIS
by Stuart Otteson

Volume II

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Stuart Otteson

*This book is dedicated to my lovely and talented
eleven-year-old daughter, Lori Otteson*

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Introduction

About ten years ago, editor Ken Warner would from time to time become very concerned over my choice of subject matter for the original volume of *The Bolt Action*. Seldom did he discuss the book without ruminating over the need for at least a few additions, like the Newton rifle, and the then newly introduced Colt Sauer. I could only defend my choices in the most pragmatic of terms. Information and cooperation wasn't that readily available to a new writer. I covered two Mossberg rifles (both now, alas, out of production), and no Ruger Model 77, for example, mainly because Mossberg's chief engineer was exceedingly gracious and cooperative, while I could at that time barely squeeze past the front gate at Southport.

While I ended up reasonably satisfied with each chapter individually, I'll admit that taken together the sixteen actions represented a less than complete, or perhaps even wholly representative, coverage of the species. The possibility of a second volume thus occurred very early in the project, particularly after it became clear that few publishers were interested in tackling a twenty-five or thirty-chapter book of this type.

As it was, the first volume of *The Bolt Action* took more time to write and illustrate than any reasonable person could anticipate — perhaps even more than justified by the ultimate rewards, tangible and intangible. I certainly could have earned a lot more money with the same time and effort spent just about any other way. Thus, when I walked out of the Manhattan offices of Winchester Press on a summer afternoon in 1976, following an all-day session with

their line editor, I had more or less resolved to find a new and less demanding avocation.

During an obligatory stop at Abercrombie & Fitch on the way back to Penn Station, however, fate intervened. After browsing through the carvings and leather goods, I decided to take a quick run up to their famed gun department. Upon alighting from the elevator and approaching the nearest counter, one particular rifle caught my eye. I'm not sure how I recognized it so fast, because in truth I'd only seen a couple of Newton rifles before. To make things worse, it turned out to be unaltered, in pretty fair condition, and priced at a disgustingly reasonable figure.

Soon after, and again quite unexpectedly, I ran across an almost mint Savage Model 1920 for sale at a local gun show. Thus began, not I believe on an entirely voluntary basis, the second volume of *The Bolt Action*. While things started off quickly enough, the going got awfully slow eventually, and it has again taken far too long. Thus I think I can safely promise that there will never be a Volume III, at least in my lifetime.

I attempted in the introduction to the first volume to define the bolt action. I won't repeat much of it here, but essentially I still feel that it is the extent to which the bolt action yields to control by the shooter that distinguishes it from all other repeating rifle mechanisms. While the *turning bolt* is not unique to the bolt action, the fact that its movement is directly under the operator's grasp is. It can be cycled fast or slow, but always without intermediate linkages whose failure might interrupt the full application of leverage and power (which, due to the internal geometry of the bolt action, is most considerable).

Equally basic is the "openness" of the bolt action. In levers, pumps, or autos, the cartridge disappears inside a closed mechanism, never to be seen again until ejected to some distant point on the ground. There is no way to observe its progress as it is stripped from the magazine, fed into the chamber, and undergoes extraction and ejection. Thus, if the mechanism falters, the reason isn't immedi-

ately obvious. In the bolt action, the cartridge moves along its journey in full view. It can even be helped along the way where necessary, and when the bolt handle is lowered solidly into firing position, there need be no doubt that the cartridge is where it should be, or that the mechanism is fully locked and set and ready to fire. Such reliability and certainty is simply unavailable in other repeating breech mechanisms.

As in my first volume, the work of Paul Mauser, in particular his Model 98, occupies unique importance, and in fact forms the basis for most of the bolt actions covered. However, more so than before, there are some pretty wide detours, and in a rifle like the Colt Sauer, for example, it becomes difficult to find a great deal of kinship with Mauser's classic principles.

The seventeen chapters of this book, with the sixteen-chapter first volume, offer a uniquely definitive coverage of this type of rifle action, probably the most complete treatment ever done. There are of course other very interesting actions, plus new ones coming along periodically, and I hope to cover at least some of these in future magazine articles.

The content of this book is, like the first, based on the actual examination of actions, plus as many firsthand interviews with their designers and engineers as possible. Its general layout also follows the first volume rather closely, except that there is better artwork. In addition to more photographs, the drawings tend to be more elaborate due to a greater emphasis on the cooperation between the various working parts of each action. It was thus fortunate that my colleagues Dave LeGate and Mark Harris were able to directly process my pencil work, rendering it into print as clearly as if it were ink. This not only saved me countless hours of work, but avoided the compromise attendant with inking-over very precision pencil drawings. Thank you Dave and Mark!

Stuart Otteson
March 25, 1982



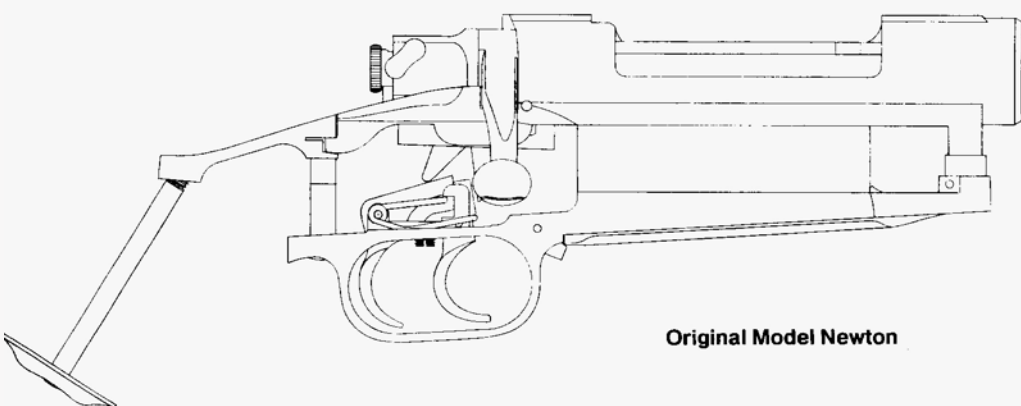
Original Model Newton

The "original" Newton rifle was a technically interesting and well-designed firearm, but a disastrous business venture. It was the brainchild of Charles Newton, a Buffalo, N.Y., lawyer who began in the early 1900s to establish a reputation as a ballistic experimenter, as well as an all-around gun authority, mostly by way of regular contributions to the gun journals of the day.

Founded in Buffalo in 1914, the Newton Arms Co. promised not only bolt action rifles, but new high-velocity cartridges to go with them. Newton initially attempted to have rifles built for him in Germany on Mauser actions. The war in Europe, however, frustrated this plan, and he received only one small shipment of rifles, all chambered in .256 Newton. He then had even less success trying to arrange for the manufacture of bolt actions to his specifications in this country, and so to satisfy a growingly impatient list of would-be customers, he was temporarily reduced to supplying stocks and barrels in kit form for the conversion of Springfield rifles into Newton sporters.

Magazine articles had been appearing for several years lamenting the lack of any home-grown bolt action sporting rifles, and urging one of the major arms companies to step forward to fill the void. Imported Mauser sporters were selling for as high as \$75, and it was estimated that a comparable U.S. rifle could be marketed in the \$25 to \$35 range.

In July 1915, *Arms And The Man* (forerunner of *The American Rifleman*) published an open letter from Charles Newton announcing that his company was developing a domestic sporting rifle. His description must have seemed almost too good to be true to those who had been urging for such an arm. Newton even invited suggestions from the public, which he promised to incorporate into the new rifle if found worthy.



Original Model Newton

Six months later, pilot rifles had been made, and the design was described in detail in a long article in *Arms And The Man*, again authored by Newton. Despite announcing that deliveries would begin in March 1916 (two months hence), Newton continued to solicit design suggestions, an early clue perhaps to his lack of common sense in matters of manufacturing and business.

Manufacturing difficulties and a shortage of operating capital delayed Newton's plans, and deliveries didn't begin until January 1917, with the basic rifle priced at \$40. Production reached a respectable level of 120 rifles per week by the end of that year, but in the meantime the company's financial basis had eroded away, and it was bankrupt by April 1918. Under Newton, approximately 2,400 rifles were made. Another 1,600 were assembled by a court-appointed receiver before operations came to a complete standstill in August 1918.

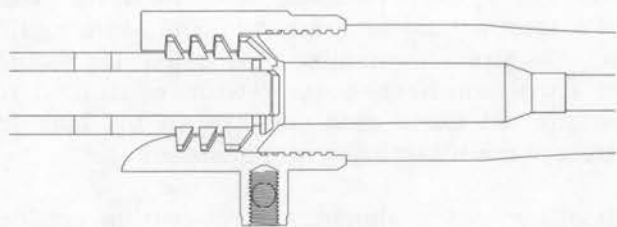
The Newton was one of the first bolt actions designed from the ground up for sporting use, and a great many features distinguished it from earlier rifle actions of the type. It surely had one of the strongest, if not *the* strongest, locking and camming arrangements, due to a screw-thread-like bolt head. It was also very pleasing to the eye. Copied to some extent after the Springfield rifle, the receiver was even smoother and more symmetrical. A graceful bolt handle and long slender tang further contributed to the making of an extremely handsome rifle.

Instead of the flip-over safeties of the day, Newton developed one mounted on the side which threw off directly to allow much faster operation in the field. There was also a true low-profile bolt handle many years ahead of its time, and the Newton can make a very practical scoped hunting rifle even today.

Original Model Newton

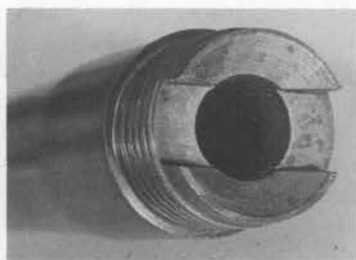
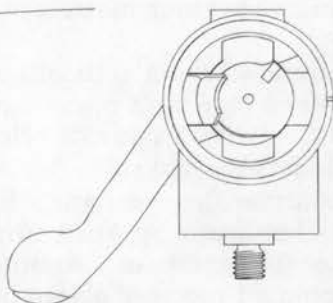
For traveling, the rifle broke down into two pieces which fit neatly into special fitted-leather "Moose Brand" carrying cases. Newton's takedown system required no tools. Because it left the barrel screwed in place, and part of the tang permanently bedded into the stock, it was not only far easier than taking out a bunch of guard screws, but the rifle held zero much better upon reassembly.

Newton's own shooting experience was largely limited to the Schuetzen game — an off-hand target competition which obviously required the best possible trigger mechanisms. Thus he favored set triggers in his hunting rifles, but rather than simply fitting the usual European double-set mechanisms, he developed and patented a much more rugged and thus practical design of his own.



Original Model Newton breech

Original Model Newton
front view

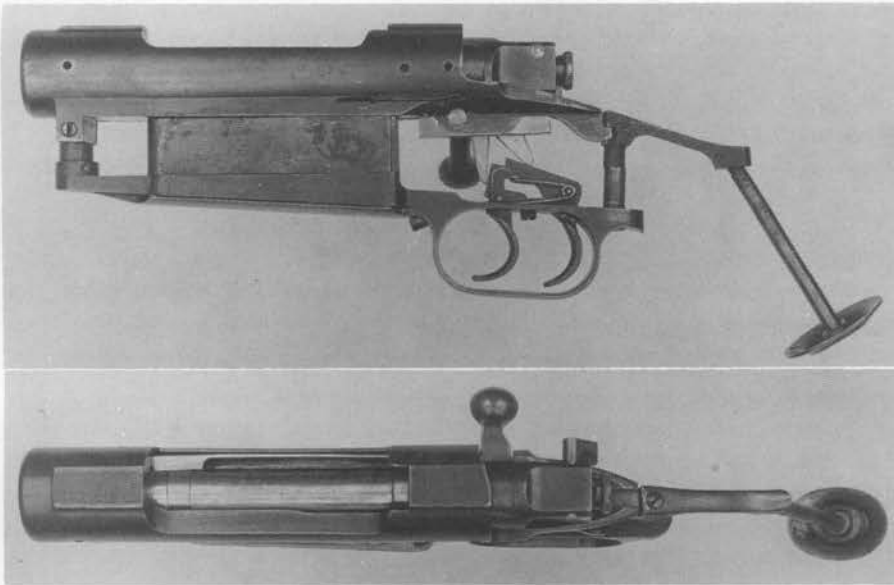


Groove sliced across both sides of Newton barrel was intended to help dissipate escaping gas from a burst cartridge head.

Newton cut a Springfield-like cone into the rear of his barrel to help smoothly funnel cartridges into the chamber, and avoid distorting or shaving lead from the nose of hunting bullets. The extractor slot cut into this cone was extended across to the left side also. It could thus combine with a hole drilled in the left wall of the receiver ring to form a special gas escape route.

Original Model Newton

Newton contended that the extractor itself jeopardized the usefulness of a conventional gas port on the right side, since expanding pressure could turn the extractor head into a sort of check valve, blocking off the port at the very instant it was most needed. Avoiding the extractor wasn't the only reason Newton relocated his port to the left side. He reasoned that the construction of the bolt head encouraged cartridges to rupture in that direction, and that the thicker walls on the left side of the receiver ring could much better afford to have holes drilled in them. To the rear, the bridge was blocked against gas flow by a flanged bolt handle, functioning in a manner analogous to the flange on the Mauser 98 bolt sleeve, while inside the bolt, leakage was controlled by labyrinth grooves in the firing pin head, much like those in the Springfield rifle.



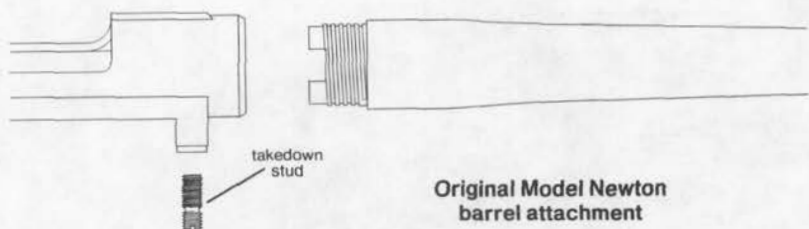
Lack of external bolt stop and ejector assembly helped make the Original Model Newton "clean as a hound's tooth." Long angled "truss bolt" at rear reinforced pistol grip of stock. Matted flats on ring and bridge were for scope blocks — although a little early in the game, there were no drilled and tapped holes.

Newton's catalogs made much of his "racy" and "stream line" receiver, and it was probably as clean and well-proportioned as any used in a bolt action rifle at that time. It had a cylindrical body positioned above a rectangular understructure and integral recoil lug like the M1903, but lacked the Springfield's "protuberances." The bolt stop and ejector were both relocated from the left wall of the bridge to an interior position. The reinforcement pad on the right side of the receiver ring was also eliminated. According to Newton, this was possible without loss of strength because he had

Original Model Newton

omitted the Springfield's right-side gas port and ejection notch, and because the design of his extractor minimized the depth of its raceway cut. Despite the rhetoric, the right wall ended up quite thin, with well less than half the thickness of the Mauser 98 or Springfield M1903 receiver rings.

In addition to optimizing the design of the receiver, and other parts of the rifle, Newton was very interested in metallurgy. Thus the bolt and receiver of this rifle, as well as the later Buffalo Newton, used a chrome vanadium alloy capable of yielding a better combination of strength and ductility than the more commonly used carbon and low alloy steels.



The floorplate, pinned to the front guard screw bushing, served as a wrench in Newton's take-down system, while rear tang simply pivots out of its seat in the "rear tang extension."

Original Model Newton

The rifle had a novel and effective takedown system, using the floorplate as a wrench for the front guard screw, and a two-part receiver tang at the rear, part of which remained bedded permanently into the stock. A bushing pinned to the front tip of the floorplate threaded onto a "takedown stud" in the recoil lug. Because this bushing always has to draw up with the floorplate aligned exactly fore and aft, the stud adjusted for wear and stock compression. With a 32 pitch on its upper threads, and a 24 pitch on those engaging the floorplate bushing, turning the stud in or out of the receiver rendered a sort of "vernier" effect, very gradually changing the spacing between the floorplate frame and receiver.

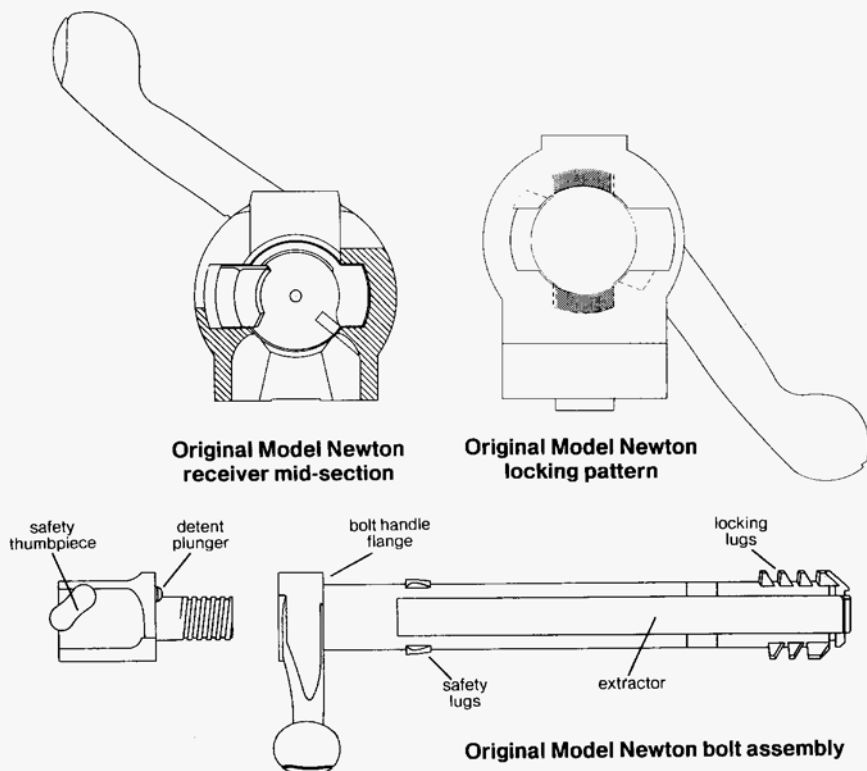
With a 0.004-inch slack or looseness in the assembled rifle, for example, the floorplate obviously couldn't turn a full 360 degrees. This would take up $1/24$ (0.042) inch, enough to either crush the wood or bend something in the action. But backing the stud out three-eighths of a turn moves it 0.012 inch, ($3/8 \times 1/32$) down from the receiver. This rotation simultaneously moves the floorplate bushing 0.016 inch ($3/8 \times 1/24$) up on the stud. The net result draws the floorplate frame and receiver together 0.004 inch ($0.016 - 0.012$), the exact amount required. In practice, of course, it would have been difficult to predetermine all of this, and more of a trial and error process existed.

At the back, a shaped block of metal called the "rear tang extension" is bedded into the stock to support the stubbed end of the receiver tang. It is drawn downward by the rear guard screw, while a smaller "tang adjusting screw" entering from above limits how far the guard screw can be turned. A long "truss bolt" angled in from the pistol grip cap reinforces the stock through the grip area. To take down the rifle, the floorplate is unlatched and rotated three turns to unthread the front bushing, whereupon the barreled action is simply pivoted out of the rear tang extension and lifted from the stock. This was not only far easier than takedown systems based on separating the barrel from the receiver, it better maintained the rifle's accuracy and point of impact upon reassembly.

The bolt is a machined forging. Recognizing the desirability of a hunting scope mounted low over the axis of the receiver far earlier than the major gun companies, Newton used a true low-profile bolt handle, patterned after the Remington-Lee. The bolt knob, checkered on the underside, was also carefully positioned close to the trigger for fast operation.

Newton claimed that his bolt sleeve blended perfectly with his "stream line" receiver. In fact, it was somewhat box-shaped. Combined with a knurled nut hanging off the end of the cocking piece, I

Original Model Newton



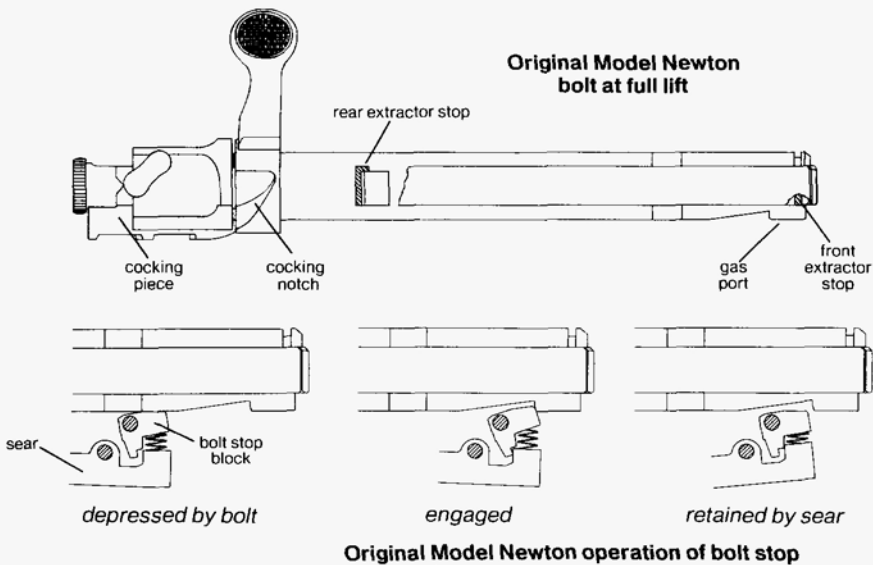
feel it actually detracted slightly from what was otherwise one of the all-time best looking bolt actions. It did match up against the rear of the bolt very nicely. Normally a threaded bolt sleeve backs away from the bolt during closing, so that regardless of how closely fitted, a gap appears upon locking. Mauser's bolt sleeve was shrouded to cover the clearance, thus improving appearance and keeping dirt out. Newton's solution was left-hand threads. These exactly reversed the sequence, so that the gap occurred only with the bolt handle lifted, disappearing again when the bolt was locked.

Newton had a gift for controversy, thriving for years on published debates concerning arms design. One of the last of these, just prior to giving up that role to become an arms maker himself, involved the importance of locking lug size, and the relative strength of the Mauser dual-lug bolt versus the Ross interrupted thread bolt. While Newton unsuccessfully championed Mauser's lugs, he was at least capable of profiting from losing causes. Thus for his own rifle, he combined the strength of the Ross bolt head — seven lugs of basic buttress thread form — with Mauser's one-piece bolt, ending up with one of the strongest and most certain locking systems ever devised for a high-power rifle.

Original Model Newton

Newton exploited these multiple locking lugs as a strong selling point for his rifle, noting that since complete failure would require the fracture of seven surfaces, his bolt had many times the strength of the Mauser. Cut on a pitch of five turns to the inch, Newton's lugs also facilitated locking and unlocking. On closing, the cartridge is not fully chambered until the final instant, thus reducing friction between the bolt face and the cartridge head. On opening, rotation immediately frees the locking lugs. The bolt is not forced to continue rubbing against either the locking seats or the cartridge base, as in a conventional square-lugged system.

Besides the root of the integral bolt handle, two special "safety" lugs turned in front of the receiver bridge to form a symmetrical backup system. To prevent jamming with the magazine during closing, these lugs were very shallow, and tapered slightly toward the front.



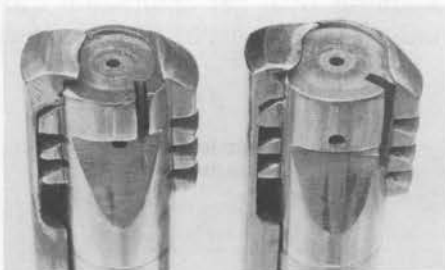
Newton's bolt guided well. The length of its front locking lugs gave inherent stability in the receiver raceways, while the rear safety lugs added support during part of the opening and closing cycles. Most important, however, Newton's extractor stabilized the bolt. "Stops" under both ends contacted at full bolt lift, interlocking the extractor and bolt together to resist upward torque from the bolt handle. It was an effective solution to a source of cramping which would in fact continue to plague bolt actions for decades after this Newton rifle was gone and, to large measure, forgotten.

A small block, pivoted behind the magazine and urged upward by the sear spring, limits bolt travel. In service this block, and even

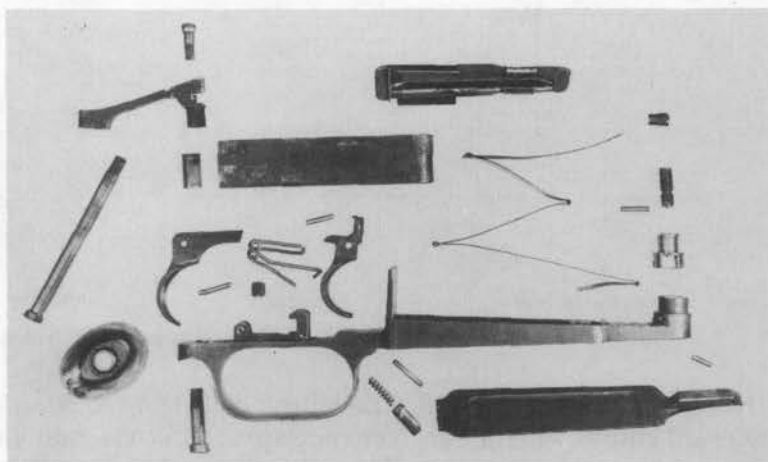
Original Model Newton

more so its crosspin, got pretty badly battered up doing its job, and sheared-off pins were frequent problems with the Newton rifle.

If the trigger was pressed *before* drawing the bolt fully back, the sear could bind the "bolt stop block" in a depressed position, freeing the path for bolt removal. This bolt stop was described as "very ingeniously arranged." But in truth, since it wasn't actually drawn downward, those unfamiliar with its unusual sequence could easily experience great difficulty getting the bolt loose, invariably withdrawing the bolt fully to the rear, thus allowing the bolt stop block to pop up into its notch, before pressing the trigger.



Early Newton rifles (left) had ejector blade vertically pivoted immediately to left of bolt stop. It angled in on a radial line in later Newton bolts (right).



One-piece forged trigger guard, housing triggers as well as the special take-down system, was as carefully machined as the receiver. In contrast, magazine box and follower were sheet metal. Simple plunger type floorplate catch was later used in Winchester Model 70.

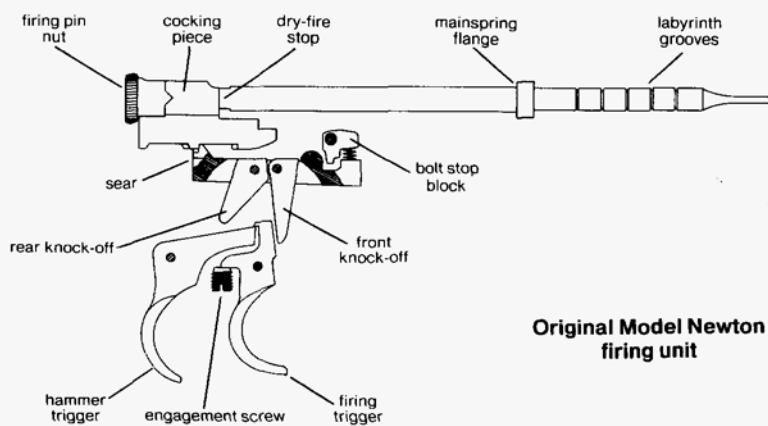
Newton used a classic blade-type ejector, but rather than cutting horizontally through the locking lugs, it entered the bolt face from beneath, a pattern later copied by Winchester for its bolt action rifles. Besides giving a cleaner path into the bolt face, this allowed

Original Model Newton

moving the ejector assembly off the wall of the bridge to an interior location in the base of the receiver.

The trigger guard was formed with the floorplate frame as a single forging, machined on top for mounting double set triggers. The magazine box and the cartridge follower were bent from sheet metal. Supporting the follower was a W-shaped ribbon spring of conventional design, except anchored directly to slots milled into the walls of the floorplate frame. This freed the hinged floorplate to function as a takedown wrench, but by the same token blocked the bottom of the magazine so that unfired cartridges could not be emptied from below.

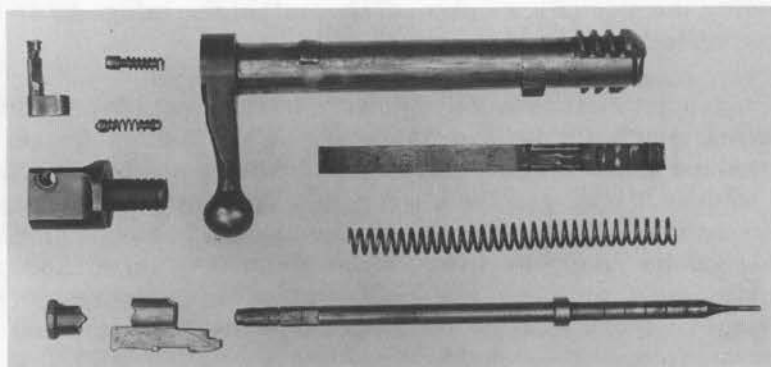
Newton's camming system handled high power cartridges with great ease and certainty. In addition to the usual cam surfaces cut into the receiver and bolt, the thread pitch of the locking lugs helped out, giving extra leverage both when primary extraction first began, and when fresh cartridges were being final-seated into the chamber.



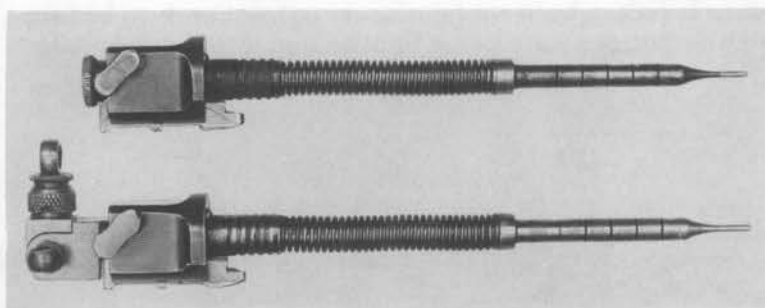
Original Model Newton
firing unit

In contrast, Newton had a remarkably inefficient firing pin construction, even though it supposedly embodied the best features of the Mauser, Springfield and Remington-Lee. It had the Mauser one-piece shaft, the Springfield gas control grooves at the front, and a cocking piece held in place with a threaded nut such as the Remington-Lee. The trouble was that after sliding onto the rear of the firing pin, the cocking piece was not really clamped in place. With the "firing pin nut" adjusted to allow proper firing pin protrusion, the cocking piece still had more than enough sliding play at the rear of the firing pin to cushion its blow. It could, in fact, impact into the bolt sleeve instead of the firing pin shaft. Thus,

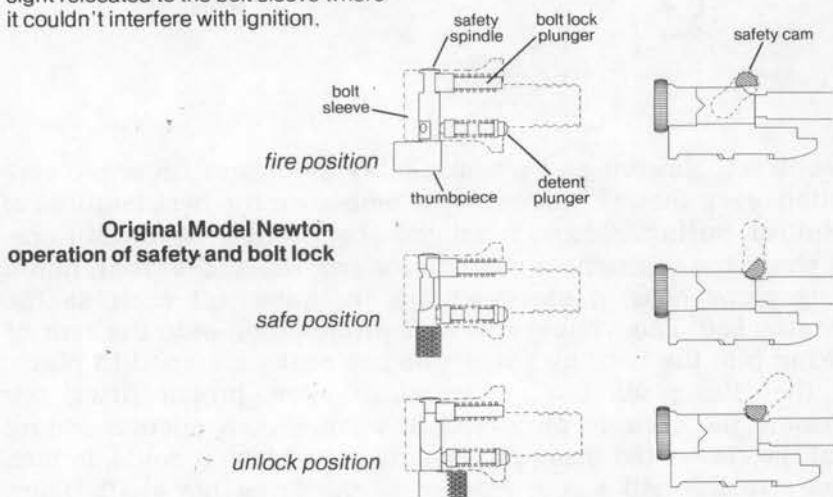
Original Model Newton



One-piece forged bolt provides strong lockup, while threaded firing pin left much to be desired from an ignition standpoint. Safety utilized two separate spring plunger assemblies.



Besides the standard firing pin nut (top), an aperture-sight version (bottom) was available at extra cost. It slowed the firing pin, and Newton's later Buffalo catalogs showed this sight relocated to the bolt sleeve where it couldn't interfere with ignition.



Original Model Newton

while the mainspring had to drag it along for the ride, the cocking piece contributed nothing to primer impact. The nut could also easily be screwed on too far, resulting in insufficient protrusion.

A long close-fitting firing pin tip was intended to help keep the bolt interior free of primer cup blankings, which Newton thought might jam movement of the firing pin. At the rear, the bottom flange of the cocking piece had an extra long bearing in the receiver tang, giving good stability, as well as helping exclude dirt from the working surfaces.

A cammed safety spindle was journaled through both walls of the bolt sleeve. In the *fire* position, with its thumbpiece pointed 45 degrees down and to the rear, a centrally located cam cleared the cocking piece, while another to the left allowed rearward movement of a spring-loaded locking plunger to free the bolt.

Rotating the thumbpiece 135 degrees clockwise to the upright position brought the spindle to *safe*. The firing pin was cammed back free of the sear, while the bolt lock plunger was simultaneously cammed forward to lock into the bolt-handle rim.

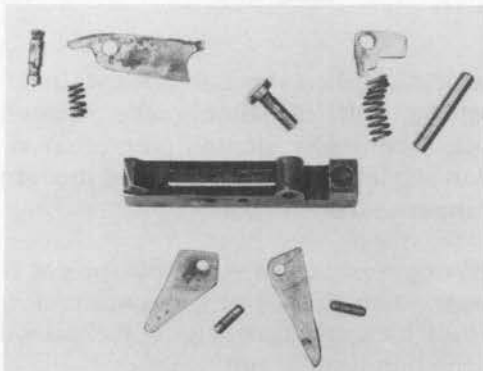
A further 45-degree clockwise rotation brought the thumbpiece to a third, *unlock*, position. The firing pin remained immobilized, but the bolt-lock plunger retracted to again allow bolt movement. Sequencing the safety in this manner was a significant improvement on Newton's part. In the Mauser and Springfield, having to go through the *unlock* position to get from *safe* to *fire* was slow and inconvenient. Thus shooters often carried these rifles with the thumbpiece already in the *unlock* position, where it could be quickly stabbed directly over to *fire* with the thumb, in the process, however, leaving the bolt handle free and the rifle thus subject to misfires.

Newton also had a fourth "scabbard" position, which was another *safe* position, but with the thumbpiece laying forward and parallel to the bolt axis so as to be less liable to catching or being inadvertently moved during handling.

This safety generally worked well, and could be operated by turning the thumbpiece in either direction. It was also easy to field strip. Probably the biggest problem arose when bolts occasionally jammed closed due to failure of the small spring to retract the locking plunger. A double-acting spring plunger on the opposite side of the safety cam pressed rearward to detent the safety spindle, while at the same time pressing forward to help maintain alignment of the bolt sleeve. Like the bolt lock, this little spring plunger didn't always work to perfection, and gouged Newton tangs and stocks were not uncommon.

Original Model Newton

The only patent issued on this Newton rifle covered its set triggers (No. 1,215,181 issued February 6, 1917). Separate "knock-offs," one for the front "firing" trigger, and the other for the rear "hammer" trigger, eliminated much of the lost motion inherent in double set triggers. Each trigger could also be made of full-width stock throughout, unlike the thin side-by-side upper blades found in the German double-set triggers.



Newton used a separate "knock-off" for each trigger. Neither the ejector nor bolt stop, both also shown, were particularly well suited for rugged service.

If pulled first, the firing trigger directly contacted the forward knock-off, rotating it counterclockwise to gradually draw the sear away from the firing pin. The rear knock-off, pivoting in the opposite direction to accomplish the same result, responded to a sharp blow from the rear trigger. This hammer trigger was latched underneath the head of the firing trigger, in the process tensioning a spring to store energy for the blow it must deliver. The amount of latching engagement, and thus weight-of-pull, was controlled by a set screw threaded into the upper web of the trigger guard.

The trigger was powered by a single length of piano wire. Formed as a double loop spring, the outer loop puts tension on the firing trigger counterclockwise, while a shorter, and thus stiffer, inner loop acts underneath the hammer trigger.

Summary

Newton made no secret or apology for the fact that his rifle was a conglomeration of what he found best in existing high-power rifles. But it ended up more than that, incorporating much that was original also. Despite flaws expected in any newly-introduced firearm, its basic design had great potential for success, and even the eventual basis for a gun company capable of challenging the Winchesters and Remingtons. Instead, it ended up little more than a relatively obscure technical artifact.

Original Model Newton

Some years later Newton blamed this failure on a government cut-off of his ammunition supply when the U.S. entered World War I. He stated that all rifle shipments were suspended until he could set up his own ammunition-making operations, and that it was during this period that his company came under the control of the banks that ultimately threw it into receivership.

But other factors contributed. Newton was as inept at business and manufacturing as he was skilled at inventing and experimenting. Finances, production and inspection weren't his forte. He was a poor manager, reportedly taken advantage of by those who worked with and for him. Compounding all this, the entire country was gearing up for war, and it would be difficult to imagine a worse time to introduce a new sporting weapon, plus try to supply special ammunition to go with it. A more prudent man would probably have waited for more favorable conditions and a stronger financial backing.

Also boding ill for Newton's fortunes as a gun maker was the lack of esteem with which he was held by some important gun writers. In earlier seeking public recognition as an arms authority, Newton had for years submitted articles and letters for publication. Perhaps due to his training as a lawyer, he tended in this correspondence to become entangled in just about any arms or ammunition controversy which came along. It didn't appear to matter greatly to him which side of an argument he took. He also didn't seem to know when to back down, or how to concede a point. These "debates," each inevitably degenerating into little more than a tedious personal exchange, accounted for some all-time lows in arms journalism.

Newton thus managed to rile a number of influential gun people. Some, like Dr. Mann, author of *The Bullets Flight*, and Harry Pope, the premier barrel maker of the day, were simply shocked and exasperated by Newton's words. They quickly withdrew from the fray, being far too busy with their own work to waste time knocking heads with him.

But a natural adversary soon appeared in Edward Crossman, a leading gun writer of the era, and capable of matching Newton at almost every turn. They locked horns on issue after issue, perhaps the most exhaustive, and eventually senseless, the so-called "Bolt vs. Lever" controversy.

Beginning as a simple discussion of the relative merits of the two action types as hunting weapons, Newton soon helped turn it into an acrimonious and petty personal exchange. Filling the pages of both *Outdoor Life* and *Arms And The Man*, as this hapless debate dragged on, it devoured enough copy to fill a book. It was finally forced from

Original Model Newton

print by outraged readers, but not before Newton had managed to say some pretty injudicious things about Mr. Crossman.

Such behavior obviously didn't behoove one who was soon to head a gun company. By the time Newton was ready to start marketing his products, he had alienated some of the nation's most important gun people, championed lever guns over the bolt action, and even belittled the interrupted-screw locking system he decided to use. If he had stuck to being a ballistics hobbyist, such conduct may have been of little consequence. But as an arms maker, these words and deeds dogged him to the end of his days.

The following summarizes the strong and weak points of the Original Newton action:

Strong points:

1. Streamlined and well proportioned lines.
2. Strong camming.
3. Strong locking system.
4. One-piece bolt with low-profile handle.
5. Convenient and direct-acting safety.
6. Mauser type extractor.
7. Excellent bolt-guide system.
8. Positive and controlled ejector.
9. Rigid receiver.

Weak points:

1. Poor ignition system.
2. Inconvenient and trouble-prone bolt stop.
3. Springfield-like breeching system.
4. Inconvenient floorplate catch.
5. Non-positive operation of bolt and bolt-sleeve locks.
6. Tend to breakage of bolt stop pin.
7. Inability to empty the magazine from underneath.

Original Newton Dimensions

OPERATING

Extraction (two-phase):

- 1st (from locking system lead): set-back — 0.03 inch
leverage — 95 to 1
- 2nd (from cams): set-back — 0.07 inch
leverage — 9 to 1

Original Model Newton

Chambering (two-phase):

1st (from cams): cam-forward — 0.08 inch
leverage — 8 to 1

2nd (from locking system lead): cam-forward — 0.04 inch
leverage — 60 to 1

Bolt rotation — 90°

Bolt travel — 4.67 inches

Cock-on-opening: 0.413 inch
mainspring compression
proportioned as follows:

opening — 0.357 inch

closing — 0.056 inch

IGNITION

Firing pin travel: at impact — 0.345 inch
dry-fired — 0.413 inch

	standard firing pin nut	aperture sight firing pin nut
Lock time (milliseconds)	4.5	5.4
Impact velocity (ft./sec.)	13.6	11.4
energy (in.-oz.)	75.0	82.3
impulse (oz.sec.)	0.92	1.20

Striker/firing pin hole diameters (inch) — 0.075/0.080

RECEIVER

Overall length — 8.43 inches (10.43 inches with tang extension)

Length of loading/ejection port — 3.23 inches

Ring diameter — 1.300 inches

Barrel threads — 1.040-10 (square form)

Recoil-lug bearing area — 0.38 sq. in.

BOLT

Lug shear area — 0.451 sq. in.

Lug bearing area — 0.387 sq. in.

Bolt diameter — 0.690 inch

Lug diameter — 0.944 inch

Bolt-face recess — 0.058 inch

Original Model Newton

MAGAZINE

Length — 3.36 inch

Capacity — .30-06 Springfield — 5
 .30 Newton (0.525 inch head) — 3

WEIGHT

Receiver group	16.6 oz.
Bolt group	15.1 oz.
Magazine/floorplate group	11.0 oz.
Rear tang assembly	1.8 oz.
Total action weight	44.5 oz.
(1.2 oz. heavier with aperture sight)	



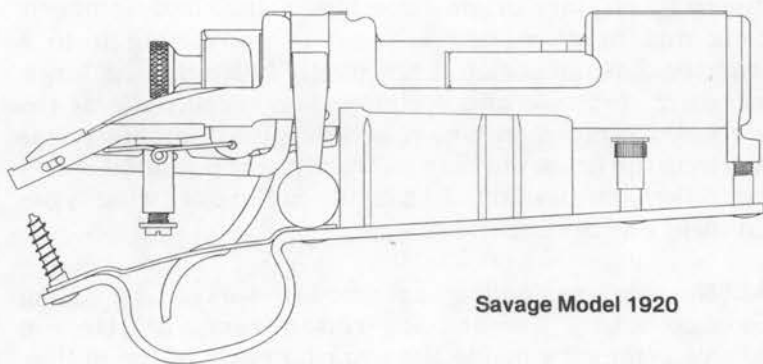
Savage Model 1920

“The rifle you have always wanted — A Savage Bolt Action.” With these words, Savage introduced the Model 1920 with a full-page ad in the May 1, 1920 issue of *Arms And The Man*. Its future must have seemed extremely bright at that point. Townsend Whelen had already gone so far as to predict “this little rifle will quickly become easily the most popular rifle in America for medium-game shooting.” And most other gun writers of the time also greeted it with enthusiasm, turning out glowing reports of its strength, looks and handling.

The public was considerably less impressed, however, and sales were never very good. A relatively brief lifespan (1920-28), combined with a limited popularity, in fact left the Model 1920 one of the most thoroughly forgotten high power rifles ever made in this country. It deserved better. If such a description can be appropriate to a gun, it was perhaps the daintiest and handiest little centerfire rifle ever built. But it was also obviously ahead of its time in some ways, with a short action tailored to the new compact Savage cartridges. Unfortunately, the time for such rifles and cartridges was still well in the future. The .30-06 Government was king. Both Remington and Winchester were chambering rifles for it. The .250-3000, and later the .300 Savage, simply didn’t equal its ballistics and ready availability.

Ironically, the Model 1920 started out life in .30-06. Even though Savage ads boasted that it was no “warbaby reborn,” it was in fact originally a prototype service arm which Savage hoped would be chosen to augment the relatively limited supply of M1903 Springfield rifles available to U.S. forces. The project got under way shortly after the outbreak of hostilities in Europe, and several pilot rifles were built at Savage’s Utica, N.Y., plant for evaluation.

Being widely recognized that the rifle output from the Springfield Armory and Rock Island Arsenal could never meet the needs of a



Savage Model 1920

U.S. expeditionary force, Savage had reasonably-founded expectations for the future of their new military rifle. But in the end, the "new" British Enfield rifle got the job. Rather than writing off its development effort, Savage shortened the action by 1-1/4 inches and introduced the rifle in commercial form in the summer of 1920. Appropriately designated the Model 1920, later often abbreviated simply Model 20, it was intended to meet the demand for bolt action hunting rifles created by returning doughboys indoctrinated in the virtues of the type.

The rifle was designed by Charles Nelson, Savage's chief gun designer of that era. Five patents were granted to Nelson on the mechanics of the action:

<i>Patent no.</i>	<i>issue date</i>	<i>subject</i>
1,177,261	March 28, 1916	recoil bracket
1,209,872	Dec. 26, 1916	firing pin
1,306,972	June 17, 1919	magazine
1,435,327	Nov. 14, 1922	extractor collar
1,446,763	Feb. 27, 1923	safety mechanism



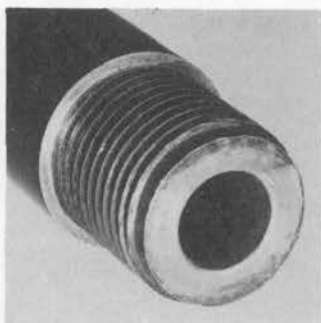
Model 1920 rifle (top) evolved from a longer-actioned military prototype (bottom).

Savage Model 1920

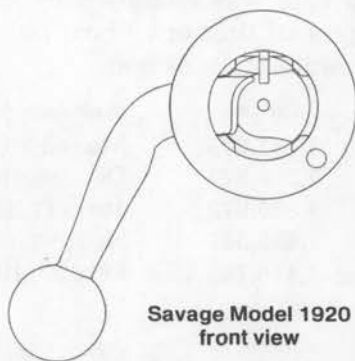
Perhaps due to its military origins, the Model 1920 had an exceptionally strong and heavy-walled action. In converting it to a "compact" sporter, Savage scaled it down only in length. Its large-diameter cylindrical receiver had a clamped-on recoil plate at the front and a riveted tang upon which a sliding button safety was mounted. Blocking the firing pin only indirectly, this patented safety was far more convenient than the then-common flip-over wing types used in the Mauser and Springfield rifles.

The fact that the rifle was "built symmetrically" served as a selling point in Savage ads. Besides its round receiver, Nelson incorporated this symmetry inside the working parts of the action. When the bolt turned to lock and unlock the breech, the non-turning bolt sleeve and firing pin assembly were supported on the top as well as underneath in the receiver groove. Below, a pressed steel box magazine incorporated some pretty advanced features of its own, helping feed and protect stored cartridges.

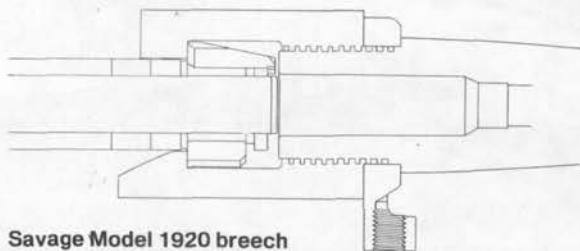
Redesigned in 1925, three years before its demise, the Model 1920 got a reshaped stock and heavier barrel. The bolt handle was bent back to bring it closer to the trigger, and the finish on the receiver spruced up from dull black to a polished blue.



Barrel of Model 1920 was un-coned, and lacked slots, grooves, and other cuts common to rifles at that time.



Savage Model 1920
front view

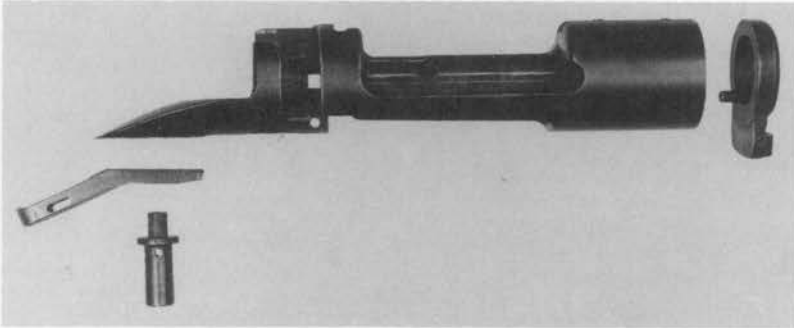


Savage Model 1920 breech

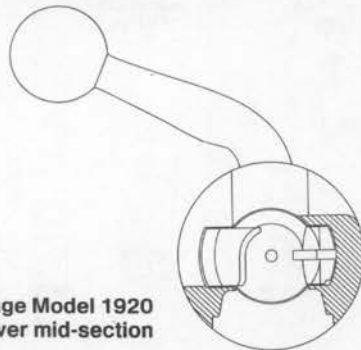
Savage Model 1920

While clearly influenced in some areas by the "Service rifle," Savage did not adopt the Springfield's cone breech, instead facing off the barrel square across at the back, with only a small radius at the chamber mouth as a concession to feeding soft-nosed bullets. The bolt face lies 0.130 inch behind the barrel. Adding a 0.020-inch radius at the chamber entrance left an effective cartridge-head protrusion of 0.150 inch ($0.130 + 0.020$), relatively little of which is encircled by the bolt rim walls. Thus Savage's breech didn't really end up with much more strength than the Springfield rifle, and it came nowhere near matching Mauser's minimal cartridge-head protrusion.

Any leakage from the breech, plus gas dumped into the left raceway by a large notch in the bolt head, had a pretty clear shot out the rear of the receiver, neither the ejector nor the small flange on the bolt sleeve presenting much of an obstacle. Like the Springfield, a flared cocking piece knob offered just about the only semblance of protection at the rear of the action.



With the recoil bracket and riveted tang stripped away, it becomes obvious that the Model 1920 had one of the first pure cylindrical receivers.



Savage Model 1920 receiver mid-section

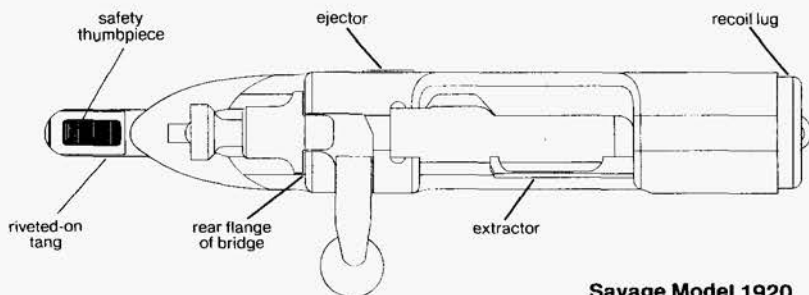
The Model 1920's cylindrical receiver preceded Remington's use of barstock for high-power rifles by some thirty years. A separate tang was riveted underneath for the safety, while up front, the recoil lug was also a separate part, clamped in place by the barrel.

Savage Model 1920

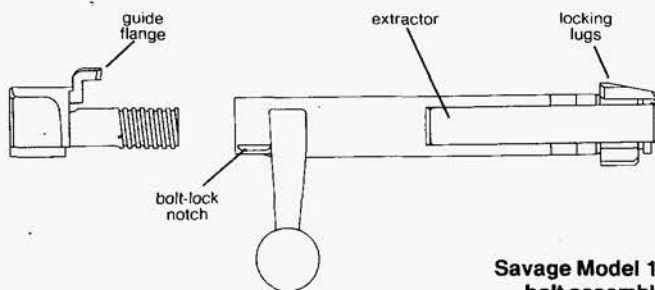
This "bracket" recoil lug, the subject of U.S. Patent 1,177,261, was more elaborate than the simple blanked plates often used today for the purpose. It was in fact a machined part, drilled and tapped underneath for the front guard screw, and aligned to the receiver by a sturdy pin.

A 1.425-inch outer diameter gave the Model 1920 exceptionally thick receiver walls, particularly over the chamber where it was bored out for only a 0.90-inch diameter barrel tenon. These walls were perfectly solid, without holes for scope mounts, guard screws, or even gas ports. The receiver ring actually appears almost more appropriate to a miniature cannon than a sporting rifle. It seemed about the ultimate in receiver-ring strength, a fact noted by several gun writers who reviewed the rifle at the time of its introduction.

The bridge was a "closed" style, milled down its middle for passage of the bolt handle. While less streamlined than a Mauser bridge, the metal left standing behind the bolt handle formed a "safety" shoulder, as well as a guideway to help steady the bolt during part of the locking and unlocking phases.



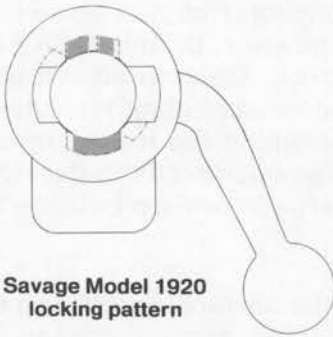
**Savage Model 1920
top view**



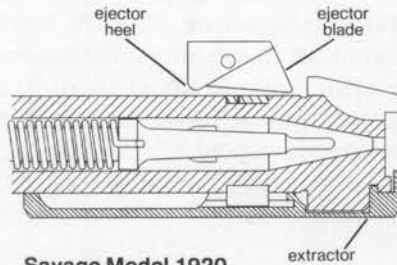
**Savage Model 1920
bolt assembly**

Savage Model 1920

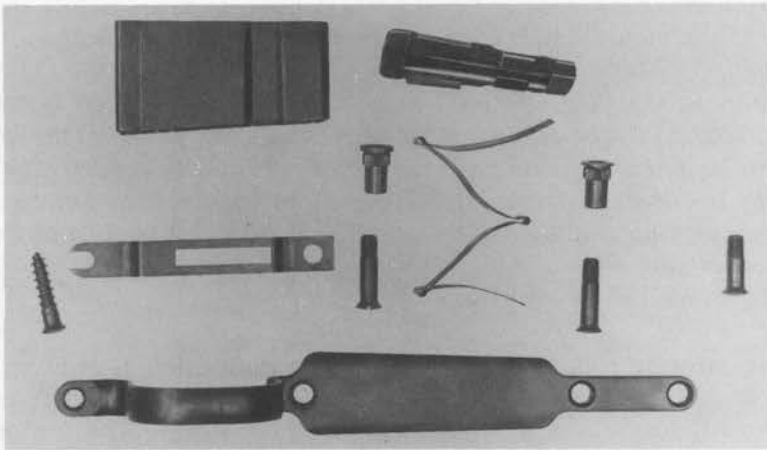
As was customary at that time, the Model 1920 had a one-piece forged bolt. Threaded to the rear was a simpler and more compact bolt sleeve than used on either the Mauser or Springfield rifles, resembling more closely in fact a scaled-down version of that used on the Newton rifles. A special flange projecting from its top engaged the roof of the bridge when the bolt handle was being raised or lowered, lessening any binding tendency within the action.



**Savage Model 1920
locking pattern**



**Savage Model 1920
bolt-head details**



A metal strap trigger guard and sheet metal follower didn't help win public acceptance for the Model 1920.

Dual-opposed locking lugs on the bolt head are shaped like those on the Springfield M1903, but of somewhat larger size. The extractor, a basic non-rotary type, terminates abruptly in the middle of the ejection port, rather than extending back to engage both ends of the receiver as in the Mauser. Even shorter and stubbier than the Springfield extractor, it not only failed to guide as smoothly as it could during bolt rotation, but contributed to the Model 1920's unfortunate lack of streamlining. Pivoted in the left wall of the receiver, the ejector is an impact blade type as in the Springfield and

Savage Model 1920

Krag. When struck by the rearward moving bolt, its front tip turns sharply into a slot in the bolt head to eject the fired cartridge case.

Unlike the Mausers and Springfields which set the standards of the day, the M1920's magazine assembly used sheet metal throughout, even for the follower. More than any other single factor, this was what potential customers and gun critics found objectionable in the rifle, particularly the metal strap used as a combination trigger guard and floorplate. A remarkable total of five screws, none actually threading directly into the receiver, tie this little Savage action and its trigger guard into the stock. Only two screws pull the receiver down, a short front guard screw threading into the recoil bracket, and an even stubbier screw behind the trigger threading into the rivet post of the rear tang. Seating directly in the stock by way of a small metal washer, this latter screw isn't visible in the assembled rifle.

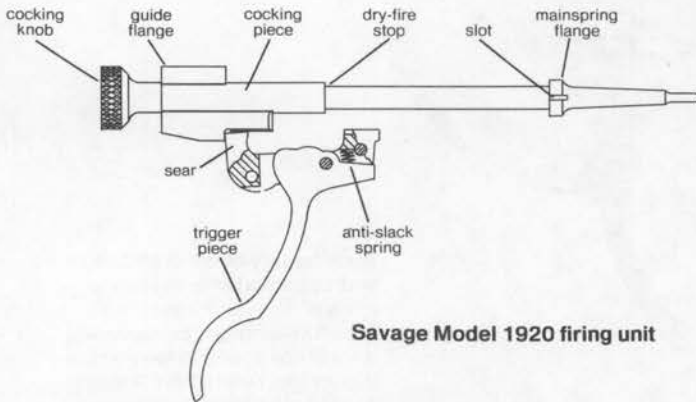
The remaining three screws act in the upward direction to fasten the trigger guard strap. Two machine screws engage stock escutcheons just ahead of and behind the magazine, while the very rear of the strap is battened down with a plain wood screw.

As detailed in U.S. Patent 1,306,972, the magazine box is crimped vertically to improve upward feed of the cartridges. The forward crimp also corresponds to the shoulder of each cartridge, thus acting to constrain forward movement and protect the points of soft-nosed hunting bullets against recoil. It was charged from the top, either by single cartridges, or with clips, for which a slot was cut in the front wall of the receiver bridge.

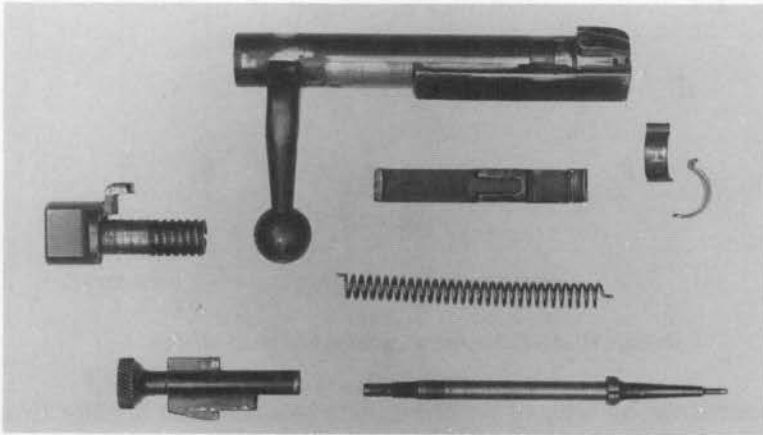
Camming in this rifle was woefully inadequate. Bolt lift renders but a 0.040-inch set-back, not enough to ensure easy extraction under all conditions in the field or on the range. The mainspring cam also came up short, and the rifle couldn't be cocked by simply raising and lowering the bolt handle, without also withdrawing it a short distance rearward.

A one-piece firing pin threads into a massive knobbed cocking piece. Several novel features in this assembly are covered in U.S. Patent 1,209,872, including a special upper flange which gave the cocking piece top and bottom guiding to reduce any binding tendency. The mainspring itself prevents turning of the firing pin, thus eliminating the need for crosspins, set screws, and the like. Its tips extend lengthwise on each end, fitting a slot in the bolt sleeve nose at the rear and one of four slots in the firing pin flange at the front.

Savage Model 1920



Savage Model 1920 firing unit



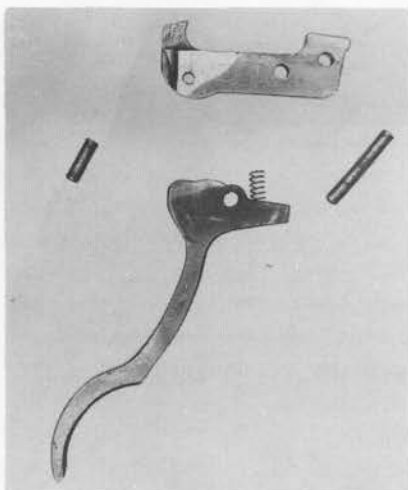
Despite patented indexing means, small mainspring failed to give the Model 1920 much ignition punch. Other patented features included top and bottom guided cocking piece and bolt sleeve, and two-piece extractor collar.

Despite such clever construction, performance of the firing pin left much to be desired, Savage somehow managing an even slower lock time than the Springfield rifle. The moving parts weren't unreasonably heavy, but the fancy little mainspring had little power. Compressed to only about nine pounds, it needed a fall in excess of one-half inch just to unleash enough energy for primer detonation.

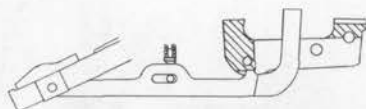
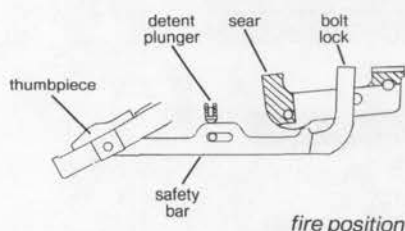
The trigger was a direct-draw pattern common to military rifles of the day, with double humps on the head of the trigger piece. The rear hump was proportioned to not only complete firing pin release, but also draw the sear down far enough for bolt removal if the trigger was pressed fully to the rear.

The safety neither engaged the firing pin directly, as in the classic Mauser system, nor did it only block the trigger as in some economy arms. Its patented construction (no. 1,446,763) instead blocked the

Savage Model 1920



Rudimentary direct-draw trigger was patterned after military rifles of the era. Instead of a return stop flange, Savage used a small coil spring to tension the trigger and keep it from flopping around after firing pin release.



Savage Model 1920 operation of safety and bolt lock

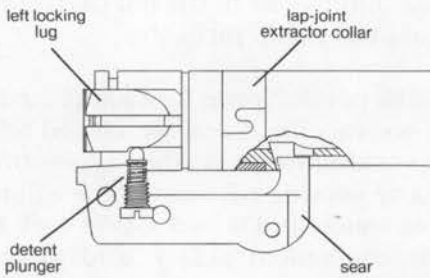
sear, operating by way of a convenient two-position sliding thumbpiece located in the tang of the receiver like those popular in hammerless double-barrel shotguns.

A long safety bar, blanked from steel plate, had blocking projections for both the sear and the bolt at its front. Its movements were controlled by the pinned-on thumbpiece, and a cross pin and detent plunger extending down from the receiver tang.

Slid forward to *fire*, an "F" stamped on the rear tang is exposed by the thumbpiece. In moving forward, the safety bar tips clockwise around its cross pin, simultaneously disengaging the sear and bolt handle. With the thumbpiece slid back to *safe*, an "S" stamped on the tang is exposed. By the time the detent plunger engages the forward recess on the safety bar, both the sear and bolt are locked against movement.

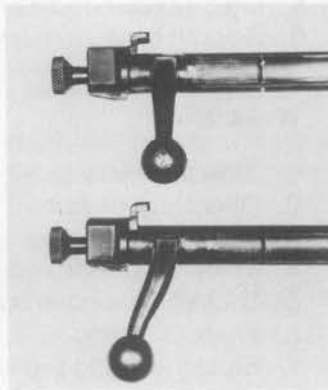
The sear had a second job as bolt stop. A notch underneath the bolt head forms a stop seat for this system just behind the extractor collar. There is also a detent to control rearward bolt movement.

Savage Model 1920



Savage Model 1920
bolt stop and detent assemblies

The flank of the left locking lug was milled down part ways to form a shoulder which works in conjunction with a small spring plunger in the receiver raceway floor, preventing the bolt from coming free without a determined yank on its handle. This is a safeguard against the bolt falling out onto the ground under its own weight if one happened to walk around with an open rifle pointed in the air and simultaneously pull back on the trigger, perhaps a legitimate concern with a trigger-actuated bolt stop.



Original bolt handle (top) was bent back slightly after 1925 (bottom) to position the bolt knob closer to the trigger.

Summary

The Model 1920 was the first really new bolt action from a major arms company following World War I. While Remington's Model 30 came out the same year, it had a surplus action. And Winchester didn't get their Model 54 onto the market until five years later.

This rifle is not to be confused with a number of very undistinguished arms which Savage subsequently used for centerfire rifles prior to the Model 110, and which somewhat resembled overgrown rimfire rifles. The Model 1920 made a very nice medium-game rifle of light weight and short length. Originally weighing but 5 pounds, 14 ounces, even the heavier barreled 1925 version was only 6 pounds, 12 ounces, which was still a good bit less than either a Remington or

Savage Model 1920

Winchester rifle. However, there was a very limited market then for bolt action rifles that couldn't be chambered in the hot cartridges of the time, like the .30-06 Government or .270 Winchester.

The Model 1920 was by no means perfect, even as a short medium-game rifle. With its enormous receiver-ring diameter, closed bridge, stubby extractor, and external cocking knob, it wasn't beautiful. It used more sheet metal than many serious riflemen were willing to accept. Its camming system was weak, and it had a slow lock time. Yet it was strong, had a most convenient safety, and generally functioned effectively. The following summarizes its strong and weak points:

Strong points:

1. Strong locking lugs and receiver ring.
2. Mauser-type extractor
3. Positive and controlled ejector.
4. Convenient and positive safety.
5. Integral bolt handle (and backup lug).
6. Smooth magazine feed and protection of bullet points.

Weak points:

1. Slow lock time.
2. Direct-pull trigger.
3. Sear bolt stop.
4. Steel-strap floorplate unit.
5. Lack of low-profile bolt.
6. Weak camming.
7. Stubby-looking profile.

Savage Model 1920 Dimensions

OPERATING

Extraction: set-back — 0.04 inch
 leverage — 12 to 1

Chambering: cam-forward — 0.16 inch
 leverage — 6.5 to 1

Bolt rotation — 92°

Bolt travel — 4.02 inches

Cock-on-opening; 0.592 inch

Savage Model 1920

mainspring compression
proportioned as follows:

opening — 0.473 inch
closing — 0.114 inch
trigger pull — 0.005 inch

IGNITION

Firing pin travel: at impact — 0.528 inch
dry-fired — 0.592 inch

Lock time — 6.7 milliseconds

Impact velocity — 13.3 ft./sec.
energy — 70.3 in.-oz.
impulse — .88 oz.-sec.

Striker/firing pin hole diameters (inch) — 0.083/0.087

RECEIVER

Overall length — 8.66 inches (9.07 inches with recoil bracket)

Length of loading/ejection port — 2.70 inches

Ring diameter — 1.425 inches

Barrel threads — 0.90-12 (square form)

Recoil-lug bearing area — 0.46 sq. in.

Guard screws — 1/4 x 28

BOLT

Lug shear area — 0.428 sq. in.

Lug bearing area — 0.111 sq. in.

Bolt diameter — 0.700 inch

Lug diameter — 0.968 inch

Bolt-face recess — 0.044 inch

MAGAZINE

Length — 2.71 inches

Capacity — 5

WEIGHT

Receiver group 20.6 oz.

Bolt group 11.8 oz.

Magazine/floorplate group 7.1 oz.

Total action weight 39.5 oz.

Buffalo Newton



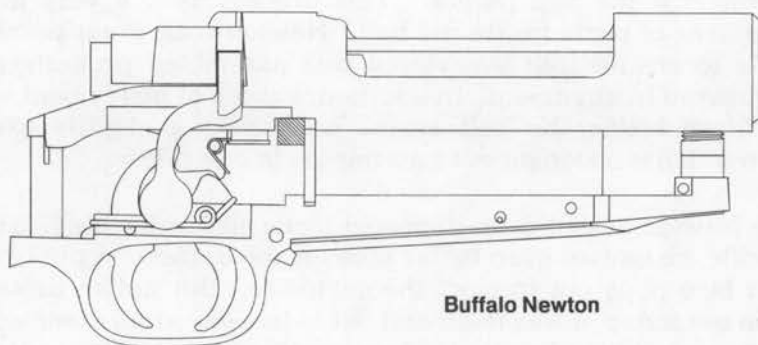
Collapse of the Newton Arms Company in 1918 didn't seem to extinguish Charles Newton's enthusiasm for the rifle-making business. He in fact kept at it right up to his death in 1932, despite the lack of any noticeable commercial success.

His second company, the Charles Newton Rifle Corporation, was formed in Buffalo, New York, in 1919. Plans included the marketing of a rifle built in Germany on Mauser actions. It was actually very similar to the rifle he sought to market in 1915, except this "Mauser-Newton" had a special "reversed" double-set trigger which would later be patented and used in the "Buffalo" rifle.

Although he began advertising these Mauser-Newton rifles very shortly after forming his corporation, German deliveries again proved unreliable, due principally to the wrecked economy of post-war Europe. A frustrating backlog of roughly one thousand unfilled orders encouraged Newton to instead launch into his second rifle-making project. These orders also gave Newton some of the leverage he needed to obtain initial financing for his venture.

The Buffalo Newton Rifle Company was formed in 1923. The company shortly thereafter moved from Buffalo, New York, and relocated in New Haven, Connecticut, where tooling was set up in a small factory previously occupied by the Fiala Arms Company. Financing was marginal from the outset and Newton constantly struggled to raise operating capital. In the process he formed what turned out to be an unfortunate relationship with a particularly zealous financier by the name of John Meeker. Meeker maneuvered to temporarily take over operation of the company in 1924, and then in 1925 set up a rival factory in New Jersey to put together "Meeker" rifles from Buffalo parts carried off from New Haven.

Continued insolvency led Newton to an unsuccessful attempt to interest Marlin Firearms Co. in taking over manufacture of the



Buffalo Newton

While loaded with innovations, the Buffalo action lacked the civility and aesthetic perfection of Newton's earlier rifle.



Buffalo rifle. What meager production there was in Newton's factory had finally ceased altogether by 1929. And when a factory clearance sale was held to dispose of the final Buffalo rifles, only somewhere around one thousand had been built, roughly one-quarter the total number of Original Model Newtons.

Newton's gift for ingenuity, if not careful and practical engineering, found full expression in the Buffalo rifle and it was far more than a warmed-over version of the first rifle. It was, in fact, one of the most thoroughly novel designs ever introduced into the conservative world of bolt action rifles.

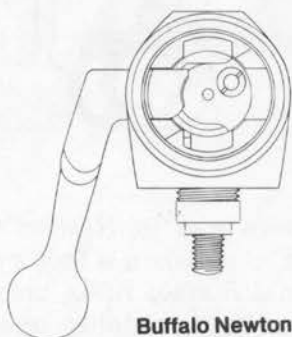
Some features like screw-thread locking lugs and a pivoted tang takedown system were carried over. But Newton, one of his own sternest critics, reworked much of the design. The action was even more symmetrical than before. While the receiver wasn't round, many of the internal working parts were cut on screw machines. A detachable recoil lug, tucked in up behind the magazine, not only seated against a stronger area of the stock, but was closer to the actual line of recoil than conventional types.

The bolt moved very steadily within the receiver, with special support to prevent cramping. Cocking of the mainspring occurred

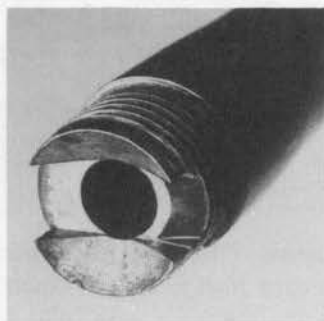
Buffalo Newton

when lowering the bolt handle. This process used a very novel arrangement of parts inside the bolt. Newton took great pains in this rifle to ensure that everything was assembled properly and always stayed in alignment. In addition, a piece of heavy bent wire which fitted inside the bolt sleeve performed a slightly exotic function which is no longer even attempted in bolt rifles.

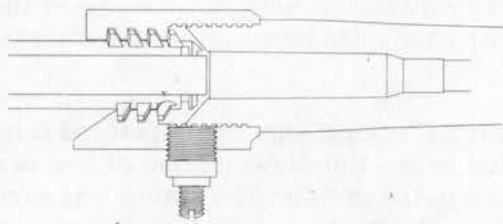
While Newton designed an improved blade ejector for his Original Model rifle, he had an even better idea for the Buffalo. A pin inside the bolt face pops out to eject the cartridge. But unlike those in common use today, it was flush and out of the way at all other times and its "punch" was a function of how hard the bolt was drawn back. Newton also managed to improve his earlier patent set trigger, rearranging the parts to give more finger room, as well as eliminate any chance of yanking the wrong trigger in a moment of excitement.



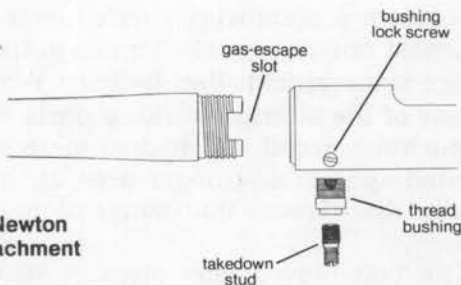
**Buffalo Newton
front view**



Like the Original Model Newton, the barrel was grooved all the way across for gas handling purposes. Added cut on right side accommodated thick head of the Buffalo extractor.



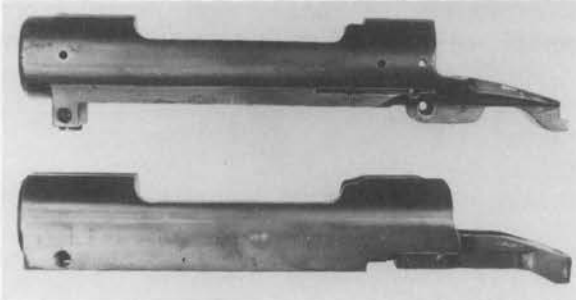
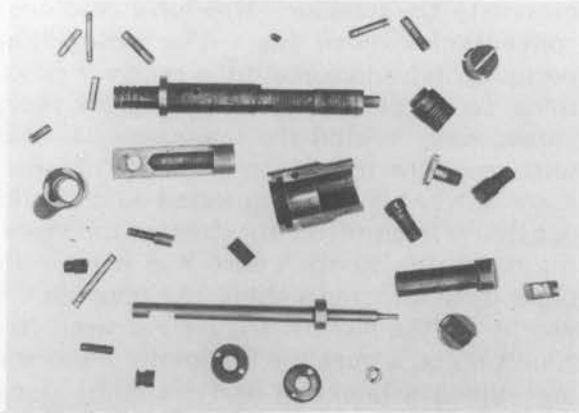
Buffalo Newton breech



**Buffalo Newton
barrel attachment**

Buffalo Newton

Newton managed to utilize a lot of "screw-machine" parts in the Buffalo rifle.



While not made from bar-stock, the Buffalo receiver (bottom) was more streamlined from a machining standpoint than the Original Model (top).

A sturdy "tie bolt," inletted into the stock and anchored on both ends by escutcheons, cooperated with a plate behind the magazine to absorb the recoil of firing.



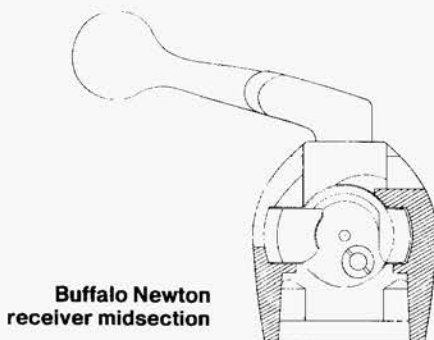
For the sake of good cartridge feed, Newton continued to use a cone breech in the Buffalo. It was also slotted across both sides as in the Original Model, however since the Buffalo had no ports in the receiver ring, gas directed to the left had now only a more or less straight shot to the rear.

By this point in his career, Newton very clearly recognized the importance of manufacturing efficiency if his rifles were to be competitive. He was quite successful with the Buffalo, boasting in fact that so much of its manufacture utilized automatic screw machines and punch presses, that it required but twenty percent of the tooling and manufacturing time needed to make the Springfield.

The receiver started out as a forging. Machining costs were controlled by a smooth symmetrical shape which avoided flanges, lugs, and other such external protuberances. The bolt stop and ejector, traditionally mounted on the outside walls of the receiver, were both

Buffalo Newton

moved to the interior. Newton's catalogs showed a more or less conventional recoil lug. The production rifles, however, were perfectly flat underneath the receiver ring, depending instead on a thick recoil plate mortised into the receiver and trigger guard immediately behind the magazine. It seated against a "tie bolt" anchored directly into the wood. This was an arrangement which allowed what Newton heralded as a "Bull Strong" stock. Pointing out that a front recoil lug stresses the stock immediately in front of the magazine cavity where it is most vulnerable, Newton's recoil plate instead acted behind the magazine where the stock is solid except for the narrow trigger mortise. In addition to distributing compression across the full width of the stock, the tie bolt prevents any outward buckling and cracking along its grain. This recoil system was also less expensive to make, and acted more concentric to the receiver centerline than traditional front-positioned types.

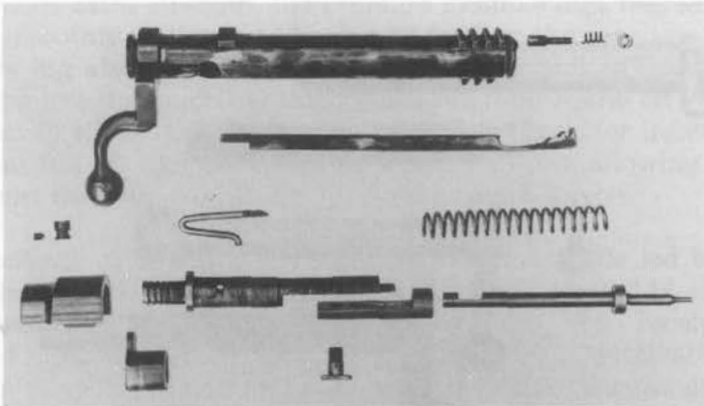
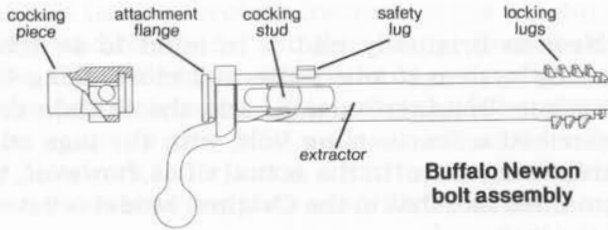
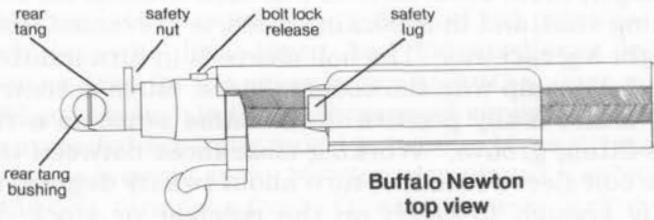


A relatively small receiver cross section (1.3 inch), combined with an extractor mounted along the outside of the bolt, didn't allow too much metal in the right wall of the receiver (less than 0.080 inch, barely half the thickness of the Mauser 98 receiver ring). Resistance to flexing along the receiver's longitudinal axis, on the other hand, was very good, due to a deep magazine shroud and a raised lip skirting the loading port.

The receiver was not drilled and tapped for scope sights, although it was milled flat on top as a partial step in that direction. Unlike the rather elegantly fashioned matting on the Original Model, a coarse herringbone knurl was run across the top of the Buffalo receiver.

The Buffalo rifle is sometimes referred to as the "dog-leg Newton." In shifting its bolt knob back to correspond to a new trigger arrangement, Newton gave the bolt handle an Enfield-like curve rather than a smooth graceful sweep. A thin and tightly radiused shank, capped by an undersized ball, yielded something more appropriate to a mail-order .22, and this handle by itself pretty much ruled out any

Buffalo Newton



While not consisting of a really extraordinary number of parts, no bolt action ever had a more novel internal arrangement than the Buffalo.

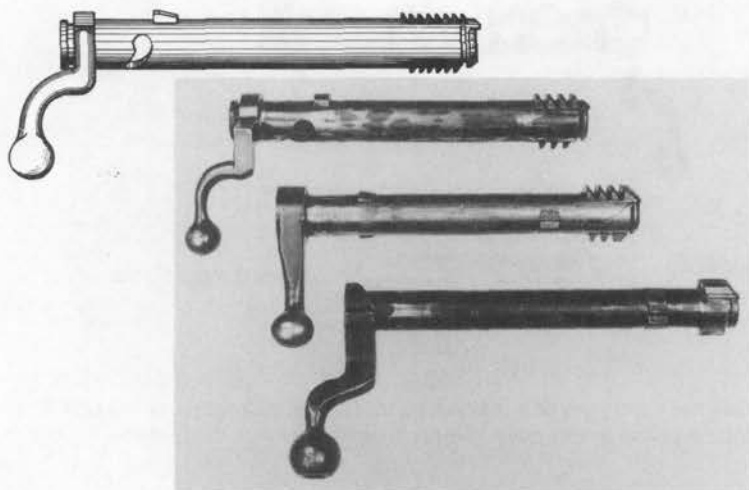
possibility of a handsome sporting rifle. It was also more of a "bent-down" than "low-profile" shape, its root coming straight out for a short distance, to avoid notching into the side of either the receiver or the stock, before turning sharply down for scope clearance.

The bolt sleeve formed a more or less tubular extension of the bolt. A shell-holder type attachment created a very strong joint between the two parts, and also one which doesn't gap when the bolt opens or closes. While this bolt sleeve dresses off the rear of the bolt and forms a purchase for a rotating type safety, it doesn't support the mainspring, nor does it close in the firing pin assembly in the conventional sense.

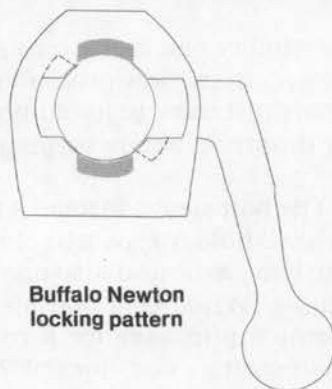
Buffalo Newton

A unique, but largely ineffective, method was used to index the bolt sleeve. The cocking stud, and thus cocking piece, is prevented from turning by the right lug raceway. The bolt sleeve is in turn indexed by an eccentric relationship with the cocking piece. Such eccentric circles, however, aren't really positive in the same sense as a rib engaging a close-fitting groove. Working clearances between the parts allowed the bolt sleeve to in fact turn about twenty degrees to either side, easily enough to catch on the receiver or stock on closing.

Newton originally had it in mind to switch from his Ross-like locking system to one patterned more along the lines of the even stronger "Neidner" action, and the Buffalo catalogs showed and described a fourteen-lug bolt, with the lugs cut on a pitch of four turns to the inch. In the actual rifles, however, the lug arrangement remained like that in the Original Model — seven lugs cut five turns to the inch.



Despite 14-lug catalog cut (top), the production Buffalo bolts (below) had same basic locking lug layout as Original Model Newton (third from top). While the Buffalo's bolt handle is sometimes compared to that of the U.S. Enfield (bottom), in truth the Enfield was almost a thing of beauty in comparison.



Buffalo Newton
locking pattern

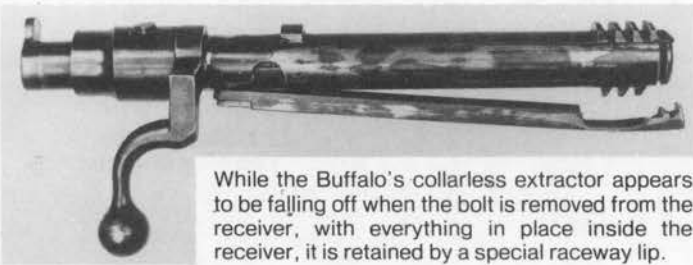
Buffalo Newton

The earliest production bolts were different, however, in the fact that they lacked cams. Since none of the potential bearing face of each lug was lost, these had extraordinary locking statistics. Bearing area for the seven lugs was 0.643 square inch, compared to 0.295 square inch in the later cammed version. Actually, either figure far exceeded anything found in two-lug Mauser type actions. Superfluous as it might seem, Newton also placed a safety lug at the rear of the bolt, turning in front of the bridge upon lockup.

Newton argued that bolt failure involves fracture at the juncture between the locking lugs and bolt body, and thus rather than shear or bearing area per se, the shell upon which the lugs are formed actually determined the bolt's strength. Since each additional lug further distributed the load on the bolt walls, it proportionally increased strength by Newton's theory, and a fourteen-lug bolt (his original plan) was seven times stronger than one with two lugs!

Besides extra strength, the Buffalo's multiple lugs helped guide the bolt smoothly as it moved back and forth in the receiver. The rear safety lug also steadied the left side during bolt withdrawal, functioning like the much-heralded guide lug later found on Winchester Model 70 rifles. On the opposite side, the extractor indexed to the bolt at full lift like the Original Model Newton, allowing it to help support the entire right side during the opening cycle.

Breakage of bolt stops in the Original Model rifle led to a much sturdier part in the Buffalo. In place of a small pivoted block, a large-diameter cylinder journaled directly into the receiver floor. Lifted into engagement by a wire spring, it was deactivated for bolt removal by the trigger and sear using the same "ingenious" scheme as in the Original Model.



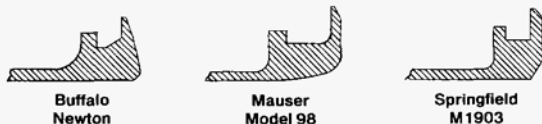
While the Buffalo's collarless extractor appears to be falling off when the bolt is removed from the receiver, with everything in place inside the receiver, it is retained by a special raceway lip.



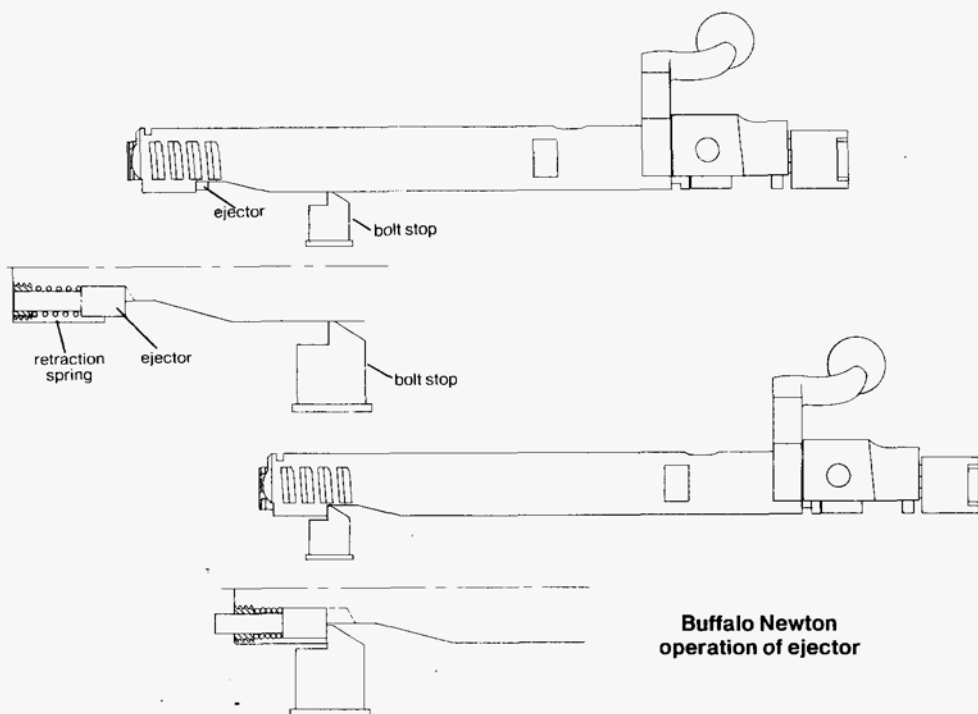
Buffalo Newton extractor

Buffalo Newton

comparison of
extractor heads



The Buffalo extractor, a bar-like part bent inward at the head, was simpler to manufacture than those used in most bolt actions of the time. Instead of a collar, and all its attendant machining operations, it is held inward simply by the lip flanking the loading port of the receiver. While the system seems a bit unwieldy with the bolt free of the receiver, the extractor tending to flop around freely, once in place it works quite adequately. Newton claimed his extractor possessed superior strength, based on a large fillet at its head. It was, in fact, massive throughout its entire length, ending up weighing about three times as much as even the big Mauser extractor.

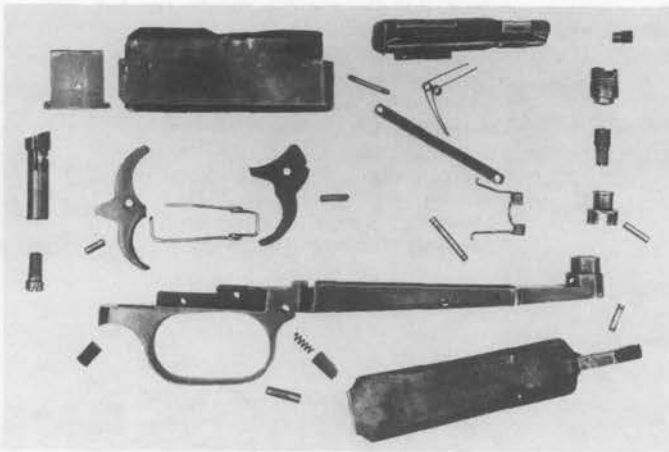


The ejector was a simple plunger mounted in the bolt face, helping, as Newton noted, do away with some exterior clutter in the receiver. Held in flush with the bolt face by a small coil spring so as not to interfere with cartridges fed directly under the extractor claw, its rear stem projected about one-eighth inch back into the bolt stop

Buffalo Newton

notch. It thus struck the bolt stop just before completion of rearward bolt travel, driving forward to eject the cartridge. The arrangement had the simplicity of the present day M-1 pin ejectors, but without spring biasing cartridges to one side of the chamber, or always ejecting them at maximum velocity regardless of how carefully the bolt is drawn back.

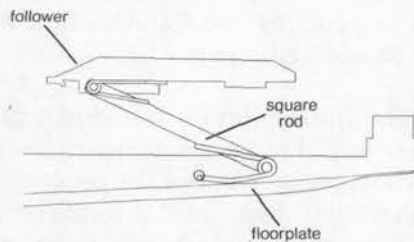
The magazine was a sheet metal affair with the cartridge lips pressed into the top. Newton claimed that such surfaces, now virtually universal in box magazine design, guided cartridges better because of their greater inherent resiliency than lips or rails milled directly into the underside of the receiver. They were also, of course, far cheaper from a manufacturing standpoint.



While similar to the Original Model Newton, novel features in the Buffalo's magazine assembly include a thick plate behind the magazine to absorb recoil, and a double-pivoted magazine spring assembly.



While both Newton rifles used sheet metal magazine boxes, in the later Buffalo version (bottom) Newton pressed the guide rails into its upper rim.

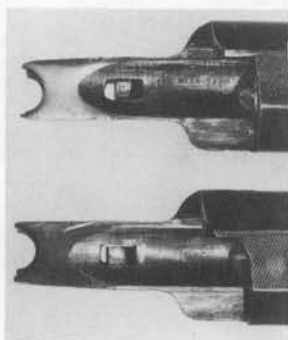


**Buffalo Newton
magazine spring system**

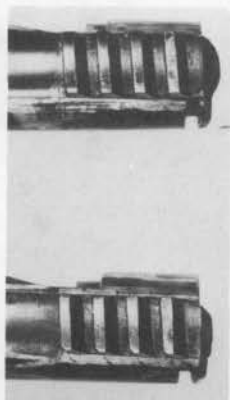
Buffalo Newton



Takedown system was similar to that of the Original Model Newton, although details were simplified for manufacture.



Early Buffalo receiver (top) lacked a cam on the bridge, utilizing only the locking lug pitch to draw fired cartridge cases out of the chamber during bolt uplift. Later version (bottom) had distinct camming wedge, more than doubling "primary extraction."



The same applied on closing. Locking lugs on early bolt (top) lacked cam leads. In later bolt (bottom) increased cam-forward movement from cam cuts allowed much smoother operation.

Inside, a sheet metal follower was pressed upward by a spring arrangement consisting of a pivoted rod actuated by bent wire springs at each end. This construction helped reduce feeding jams by supporting the follower in a more stable manner than the usual W-shaped ribbon spring.

The Buffalo had a takedown system similar to the Original Model Newton. Lacking a forward recoil lug, however, a special bushing was necessary under the receiver ring to supply threads for the front takedown stud. Dual threads on this stud allowed a very fine takeup of play, but in an apparent oversight, Newton neglected to provide a means to lock the stud once it was properly set. A long bushing at the rear forms the seat for the receiver tang. Its head is angled to blend with the lines of the receiver, and slotted crosswise to allow inserting a screwdriver when tightening the rear guard screw from

Buffalo Newton

underneath. This slot also gave some resilience to protect the stock against chipping if the recoil lug set back slightly.

Newton had carefully studied Ross's reliance on an interrupted-screw locking system for camming cartridges into and out of the chamber, rejecting such a system for his Original Model only due to the difficulty of obtaining enough displacement, or as he called it, "draw," without resorting to either oversized locking lugs or an overly fast locking pitch. In the Buffalo, however, Newton pulled out all stops in an attempt to streamline production. Thus he did eliminate the cams, whose generation entails the relatively slow and expensive process of shaving inclines into the receiver.

With locking lugs cut on a lead of five turns to the inch, a draw of 0.050 inch was theoretically possible over a 90-degree rotation. Due to tolerances and play in the various parts, however, the effective distance did not exceed 0.040 inch, much less than the Mauser 98 (0.160 inch) or Original Model Newton (0.120 inch). Thus the early Buffalo rifles, while possessing enormous leverages, couldn't properly chamber or extract cartridges. If slightly oversized or dented, they interfered with even starting the bolt handle down, while full bolt handle lift sometimes left soft or overexpanded cartridge cases clinging to the chamber walls, necessitating the judicious use of a boot heel on the bolt handle.

Few shortcomings in a high power rifle are more exasperating, and Newton shortly retooled a camming angle into the rear ledge of the receiver bridge to give an extraction "kick" to the final phase of bolt lift. Cam leads were also angled into the locking lugs and seats to help start the bolt handle down on closing. These changes restored the Buffalo to a smooth and dependable field rifle.

Its means for cocking the mainspring was perhaps the Buffalo's most novel feature. Although rifles were commonly classified as either "cock-on-opening" or "cock-on-closing," neither conventional type in fact cocked entirely on the opening or the closing cycle. The terms actually differentiated between those rifles where enough mainspring compression occurred during bolt lift to allow bolt turndown to finish the job, and those where so much remained that the bolt handle had to be pumped forward directly against the mainspring on closing.

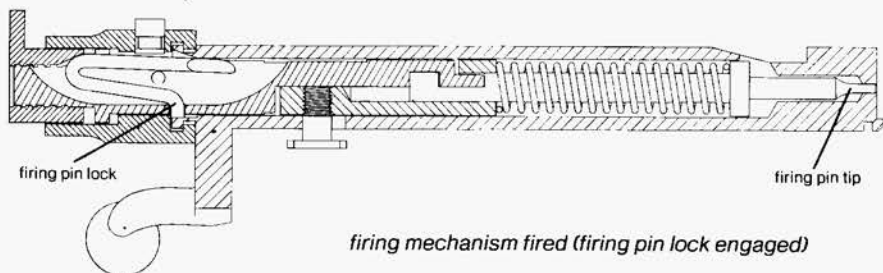
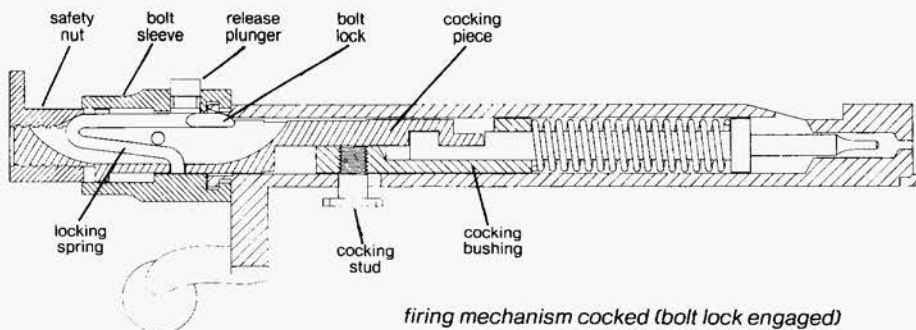
Both of these conventional systems also support the mainspring at the bolt sleeve nose, and have a cocking cam in the bolt rim which draws the firing pin back to compress the mainspring during bolt lift. Upon closing, the firing pin is caught by the receiver-mounted

Buffalo Newton

sear, allowing forward movement of the bolt assembly (either by camming or pushing) to complete mainspring compression.

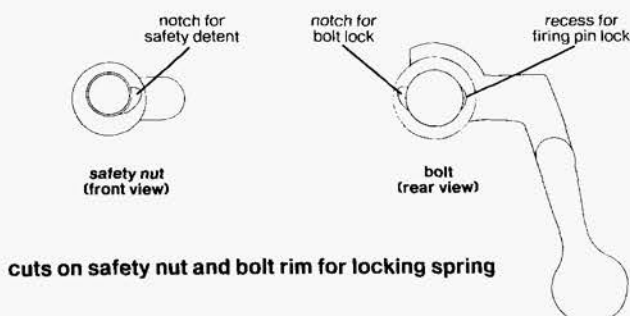
Newton's Buffalo utilized an entirely different process. An internal "cocking bushing," moved in both directions by a cam "window" milled into the bolt walls, supports the mainspring. On opening, everything inside the bolt slides freely as the busing is cammed rearward. This retracts the striker tip into the bolt face, but does *not* compress the mainspring. On closing, the sear catches the cocking piece and firing pin, so that as the cocking bushing is cammed forward, the mainspring is fully compressed for firing.

Thus unlike previous cock-on-closing systems, the mainspring was compressed entirely by camming action. And occurring on the downward stroke of the bolt handle, the left hand gripping the forearm of the stock can naturally oppose this pressure. In cock-on-opening systems, camming resistance combines with the extraction effort to tend to roll the rifle out of the shooter's grasp. While Newton's claim that "the rifle cocks so easily you cannot feel that it has a mainspring" was perhaps a little exaggerated, it was a highly effective arrangement.



**Buffalo Newton
operation of locking spring**

Buffalo Newton



Before describing the firing pin and safety, we must examine the "locking spring," a multipurpose gadget installed in the rear of Newton's bolt. Housed under tension inside the cocking piece, both ends of this heavy bent-wire part bear outward. The right outturned end protrudes through a hole in the wall of the cocking piece, causing the locking spring to follow the firing pin back and forth.

With the rifle cocked, the longer left tip rests in a diagonal notch in the bolt rim, acting as a ratchet to lock the bolt closed. It moves forward out of the notch and into the bore of the bolt proper upon firing, freeing the bolt to then be opened. This "bolt lock" thus engaged automatically each time the rifle was cocked, safeguarding against misfires from a partially raised bolt handle. It could be overridden to allow opening the bolt without firing by pressing a small button on the left wall of the bolt sleeve.

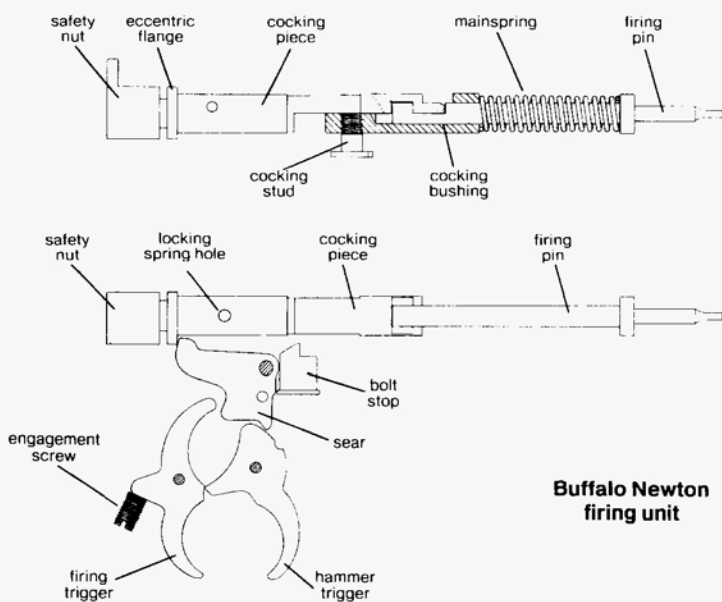
The right hook, which Newton termed the "firing pin lock," bears against the inside wall of the bolt sleeve. When the rifle fired, this hook carried past the bolt sleeve, falling into a shallow recess in the bolt rim at the same instant the tip of the firing pin was passing through the bolt face. Since the exploding primer could thereupon force the firing pin tip back only flush with the bolt face, the firing pin acted momentarily as part of the bolt face to prevent blanked primers. Bolt opening rotation cammed the right hook inward, allowing it to recross the junction and move once again back into the bolt sleeve.

Not only did each end of the locking spring have a job, its rear curve fit a diagonal notch in the safety nut to keep it from working loose from the cocking piece. Yet clever as all this sounds on paper, tolerances and heat treatment weren't up to par, and the device seldom worked well. Worn and battered tips didn't positively engage their notches, instead only managing to add drag and friction to the bolt and firing pin. Despite Newton's claims that the locking spring rode freely and offered no resistance to normal bolt operation, in fact it tended to bind the bolt, as well as drain power

Buffalo Newton

away from the mainspring. It didn't even do a particularly good job preventing the safety nut from rattling around on the end of the cocking piece.

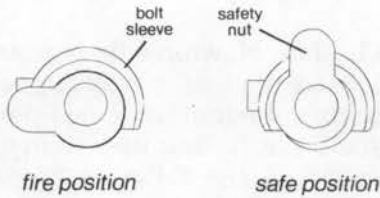
Besides the right tip of the locking spring, only the threaded-on "cocking stud" kept the firing pin assembly inside the bolt. Because of the "shell holder" attachment of the bolt sleeve, the firing pin assembly slips directly out the rear of the bolt sleeve during disassembly, a rather startling procedure for those accustomed to seeing bolt internals which are captured, and sometimes even completely shrouded, by the bolt sleeve.



The firing pin assembly was a jointed construction. Undercuts connecting the firing pin and cocking piece are encircled by the cylindrical cocking bushing which independently slides back and forth inside the bolt and supports the mainspring at its front rim. An eccentric flange near the back of the cocking piece catches on the sear during closing to allow cocking the rifle. Behind the flange, a coarse set of threads accommodate a safety nut which caps the firing pin assembly.

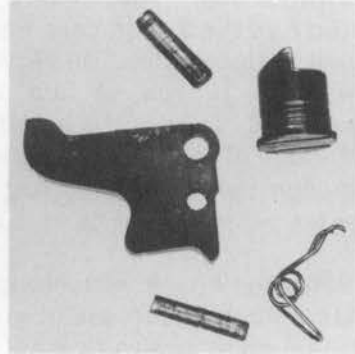
This "jointed" firing pin gives the same spongy impact for which the M1903 Springfield was famous. Take-up is about 0.005 inch, and the "cushioned" mass — the cocking piece, locking spring, and safety

Buffalo Newton



**Buffalo Newton
operation of safety**

Buffalo sear was a single pivoted piece. Bolt stop plunger (upper right) was much sturdier and more solidly mounted than the pivoted block used in the Original Model Newton, but was deactivated for bolt removal in the same way by pressure from the sear.



nut — represent about 75 percent of the impact. Dragging the safety along on each shot, harkening back to black-powder rifles, didn't help add zip to the ignition system either. In all, it was a particularly ineffective arrangement, almost rivaling the inept job Newton did on his Original Model.

A flanged nut, threaded to the end of the firing pin assembly, acted as a two-position safety. Its outer diameter and threads were eccentric. A quarter turn of the flange to the upright position thus both advanced the safety nut and shifted it peripherally into the rear rim of the bolt sleeve, in the process camming the firing pin assembly back away from the sear.

As in the first Model, a set trigger was the Buffalo's only patented feature (no. 1,581,763, issued April 20, 1926). Unlike traditional double set triggers, with the "hammer" at the rear and "firing" trigger forward, Newton interchanged the parts. More important, the hammer trigger was then turned backwards for operation with the thumb. While this arrangement at first looks a little awkward, it eliminated any possibility of pulling the wrong trigger at the wrong time. It also avoided an extra long reach by the trigger finger, and the attendant danger of barking that knuckle on the trigger guard. Finally, it allowed an almost normal-sized trigger guard, so that the hammer trigger could be removed and discarded if desired without the rifle appearing unnatural as a single trigger version.

On the negative side, the sear lacked a camming system, and was drawn down directly by a hook-like upper finger on the rear trigger. Thus, Newton's claims notwithstanding, in the "unset" mode, it couldn't operate as smoothly as standard single triggers of the day.

Buffalo Newton

Summary

For pure design ingenuity, the Buffalo Newton rifle is practically without peer. Had everything worked the way it was supposed to, and had the action been better looking, it might have "led the van of bolt actions rifles," as Newton would put it. But they didn't, and it wasn't. It was, in fact, as homely as the Original Model was graceful. Part of the sacrifice in appearance was accounted for by the use of manufacturing short cuts and a rougher finish. But the design itself was also responsible, and one must wonder how the same person could have laid out both rifles.

Newton's lack of technical perspective was a serious handicap. Like other unsuccessful gun designers, he seems to have been too intent on incorporating his various novel design ideas, each perhaps meritorious in itself, to carefully weigh their effect on the overall rifle. Also he simply failed to carry through on many of his intentions. For example, in introducing the Original Model rifle he pledged to acquire the "thousands of dollars worth of jigs and gauges" that would ensure the rifle was "built strictly on the interchangeable part system." Yet a few years later in describing his Buffalo rifle, he again stated that "all parts are strictly interchangeable," while in the same breath admitting that "the old Newton was not strictly interchangeable." In fact neither rifle would win any awards for uniformity of manufacture or inspection.

Add to such technical shortcomings the constant shortage of finances, and the fact that the rifle got even less press coverage than Newton's Original Model, and you had the perfect ingredients for another dismal commercial failure.

The following summarizes the strong and weak points of the Buffalo Newton action:

Strong points:

1. Strong operating cams (cammed versions).
2. Strong locking system.
3. Non-rotary extractor.
4. Excellent bolt guiding.
5. Positive and controlled ejector.
6. Rigid receiver.
7. Effective cocking system.
8. Strong recoil lug arrangement.
9. Stable magazine spring.

Buffalo Newton

Weak points:

1. Poor ignition system.
2. Inconvenient bolt stop release.
3. Springfield-like breeching system.
4. Uncertain retention of firing pin assembly.
5. Homely and awkward-looking lines.
6. Poor unset trigger performance.
7. Non-locked receiver stud.
8. Ineffective bolt-sleeve indexing system.
9. Inconvenient floorplate catch.
10. Inability to empty the magazine from underneath.

Buffalo Newton Dimensions

OPERATING

Extraction (two-phase):

1st (from locking system lead): set-back — .03 inch
leverage — 85 to 1

2nd (from cams): set-back — .06 inch
leverage — 11 to 1

Chambering (two-phase):

1st (from cams): cam-forward — .10 inch
leverage — 9 to 1

2nd (from locking system lead): cam-forward — .03 inch
leverage — 75 to 1

Bolt rotation — 90°

Bolt travel — 4.63 inches

Cock-on-closing; 0.360 inch
mainspring compression
proportioned as follows:

opening — 0
closing — .360 inch

IGNITION

Firing pin travel: at impact — .308 inch
dry-fired — .360 inch

Lock time — 4.4 milliseconds

Impact velocity — 12.1 ft./sec.
energy — 84.4 in.-oz.
impulse — 1.16 oz.-sec.

Striker/firing pin hole diameters (inch) — .075/.080

Buffalo Newton

RECEIVER

Overall length — 8.44 inches (8.64 inches with rear bushing)

Length of loading/ejection port — 3.16 inches

Ring diameter — 1.295 inches

Barrel threads — 1.040-10 (square form)

BOLT

Lug shear area — .358 sq. in.

Lug bearing area — .295 sq. in.

Bolt diameter — .686 inch

Lug diameter — .915 inch

Bolt-face recess — .060 inch

MAGAZINE

Length — 3.41 inches

Capacity: .30-06 Springfield — 5

.30 Newton (.525 inch head) — 3

WEIGHT

Receiver group 18.2 oz.

Bolt group 13.8 oz.

Magazine/floorplate group 13.1 oz.

Total action weight 45.1 oz.

SCHULTZ & LARSEN

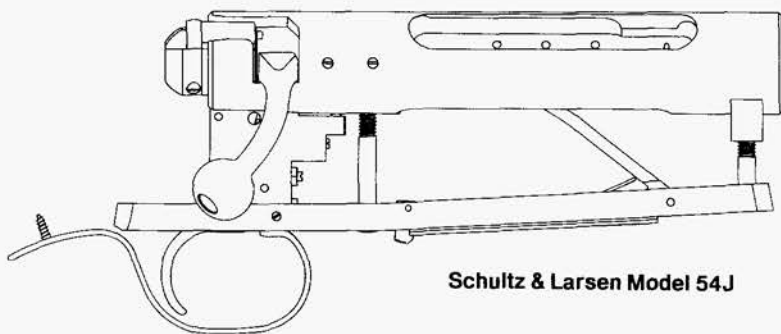
Schultz & Larsen Model 54J

The Schultz & Larsen Rifle Co. of Otterup, Denmark, goes back more than seventy years, when Hans Schultz and Niels Larsen set up a small shop to assemble high quality match rifles. While remaining very small even to this day, the competition arms produced there through the years have gained worldwide recognition.

A few years after World War II, Uffe Larsen, the oldest of the four sons of Niels Larsen who now run the company, began work on the design of their first high power rifle action. From this effort evolved the Model 54 match rifle and the Model 54J sporting rifle. The "J" in the latter rifle stood for "hunting," and was supposed to differentiate between the two versions. It was a rather subtle distinction however, and led to a lot of customer confusion on this side of the Atlantic. Thus, on later Schultz & Larsen models, the match and sporting rifles carried entirely different numbers.

Two Model 54J prototype rifles were built for evaluation in 1953, one of which was earmarked for Phil Sharpe, the noted gun writer and cartridge experimenter of Emmitsburg, Maryland. Sharpe had struck up an acquaintance with Schultz & Larsen, as well as others in the Danish arms industry, during a brief postwar tour of duty in Copenhagen. After leaving the army in 1946, he embarked on a long and costly project to develop a cartridge which would bear his name. By 1953, he and a partner had perfected what they called the 7x61 Sharpe & Hart, and were looking for a way to elevate it from "wildcat" to "factory" status. As such, Sharpe felt it could serve as a lasting monument to his contributions to the shooting world. The new rifle thus presented a propitious opportunity for Sharpe, while he also, of course, obviously felt that he and his new cartridge could contribute to the success of this Danish rifle.

Sharpe's pilot rifle arrived in Emmitsburg in January 1954, and by the summer of that year "Sharpe & Hart Associates, Inc." was



Schultz & Larsen Model 54J

formed to market Schultz & Larsen rifles in the U.S. At the same time, Sharpe struck a deal with another Danish company, Norma, for manufacture of 7x61 ammunition so it would be readily available when offered as a factory chambering in the new rifles. Thus all fell neatly into place to fulfill Sharpe's longtime dream of seeing a "factory" cartridge of his own on the marketplace.

U.S. deliveries of the Model 54J began in January 1955, continuing through early 1957. In addition to the 7x61 cartridge, the new rifle was offered in .30-06, .270 Winchester, .244 Remington, and 6.5x55 Mauser. There were also some rifles supplied during this period through Roy Weatherby, chambered in his oversize .378 Magnum cartridge.

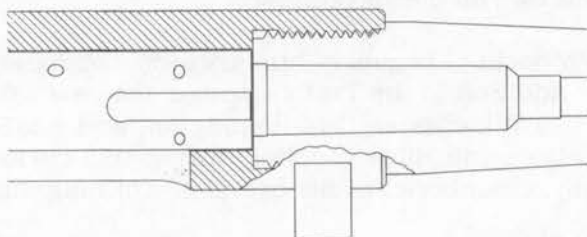
Uffe Larsen had a mind of his own, and the design of this precision-made Danish action pays relatively little homage to Mauser's precedents. The bolt locks back near its handle. Four evenly spaced circumferential lugs render barely more than half the usual bolt rotation. The receiver is almost a pure tube, encasing the breech with thick walls, and accepting a long internally-seated barrel tenon. The bolt, with an abbreviated linear as well as rotational travel, is guided by a spring lever pivoted in the side of the receiver. It cocks on the forward and downward movement of the bolt handle. Inside, a needle-like firing pin is controlled by an adjustable blocked-sear trigger and a direct-acting safety in the bolt sleeve. Cartridges are stored single-column, lifted to the breech by means of a peculiar finger-like magazine feed system. Depth of this magazine leaves the assembled rifle bulged at its midsection, while a fancy bent-metal trigger guard bow adds an overly ornate aspect.

Being a rear locked action, cartridges in the Model 54J are breeched in a rather "springy" manner, nowhere near as solid as virtually any front-locked action one might choose to consider. At the same time, this arrangement allows a superior encirclement and

Schultz & Larsen Model 54J

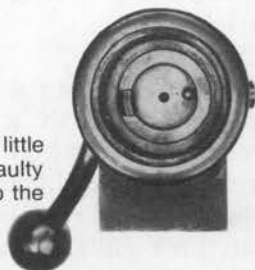
shrouding of the bolt head. This is the dichotomy of the rear-locked action, and the source of considerable confusion and argument through the years.

Action "spring" is examined later in this chapter. We will first consider the beneficial aspects of a rear locking system on the breech. It is hard to imagine a bolt action of any reasonable size and weight that could offer much greater strength or protection to the shooter in the event of a burst cartridge head than does the Schultz & Larsen. Without locking cavities or other undercuts in the breech area, the bore of the thick-walled receiver perfectly encircles the bolt head, naturally forming the kind of shroud which Paul Mauser could attain only by means of a special receiver-ring diaphragm. In the M54J, both the bolt circumference and the receiver bore are also ground to final dimension, giving almost a push fit between them. Bolts and receivers are often said to fit closely, but few even approach the precision of this Danish action.



Schultz & Larsen Model 54J
breech

Schultz & Larsen breech allows little opportunity for gas released by a faulty cartridge case to penetrate back into the action.



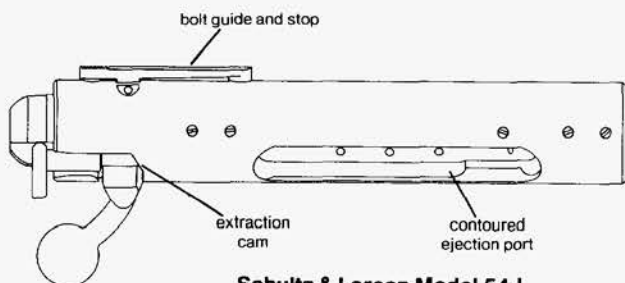
As in the Mauser 98, Model 54J barrels seat directly against an interior shoulder of the receiver ring which lies essentially even with the front of the bolt. Thus "breech gap," which measured just .003 inch in my sample rifle, is built permanently into each action at the factory. Due to the precision with which the barrels are cut, they also make secondary contact at the exterior face of the receiver upon being fully drawn up.

Even though the locking cavities are eliminated, for purposes of aesthetics, the length of the receiver ring in a rear-locked action is seldom shortened a corresponding amount. Since bolt travel obviously isn't going to be increased to allow the bolt nose to fill this extra space, the barrel tenon is lengthened. Thus like many rear-

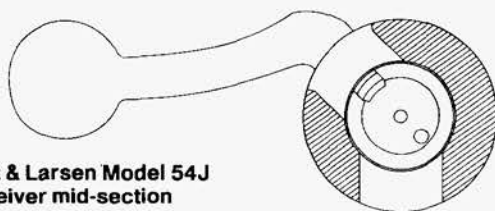
Schultz & Larsen Model 54J

locked actions, the barrel of the Schultz & Larsen penetrates very deeply into the receiver ring.

Behind the breech, thick and solid receiver-ring walls are capable of safely containing the expansion of a defective cartridge, while the close circumferential fit of the bolt (barely .002 inch in my sample rifle) can block pressure from entering the bridge and reaching the shooter's face. Inside the bolt, the mainspring flange is slotted on both sides to minimize susceptibility to escaping gas. Three ports drilled in the bolt body behind this flange release pressure into the ejection port of the receiver. Interestingly, both this slotted flange and the triple in-line bolt vents were later featured in Weatherby's new Mark V action, which in 1958 supplanted both the Schultz & Larsen and FN bolt actions used up until then as the basis for Weatherby Magnum rifles.



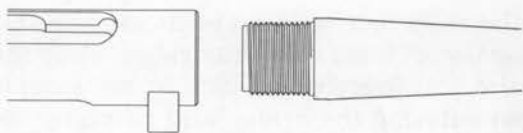
Schultz & Larsen Model 54J
top view



Schultz & Larsen Model 54J
receiver mid-section

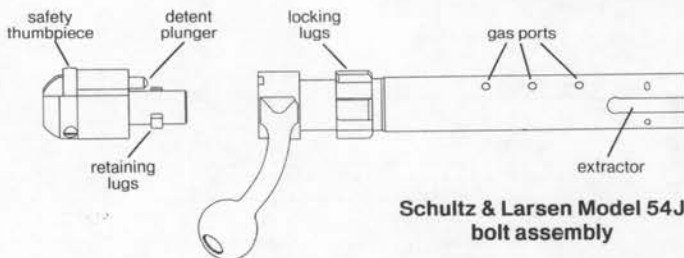
The receiver of the Model 54J is tubular. Square on both ends, without even a discernible rear tang, it, in fact, more resembles an overgrown .22 rimfire receiver than anything else. Minimal-sized magazine and ejection port cutouts, combined with a complete lack of locking-seat cavities in the receiver ring, or raceway channels along the middle of the receiver, yield exceptionally thick and rigid walls. Even with a .75 inch diameter bolt, they end up .29 inch thick. Such strength is typical of many modern rear-locked actions. The receiver wall thickness of the rear-locked Remington Model 788 and Nikko Model 7000, for example, is .31 and .30 inch respectively.

Schultz & Larsen Model 54J



**Schultz & Larsen Model 54J
barrel attachment**

Receiver is threaded deeply for barrel. Behind recoil lug is a very narrow cutout for the single-column magazine.



**Schultz & Larsen Model 54J
bolt assembly**

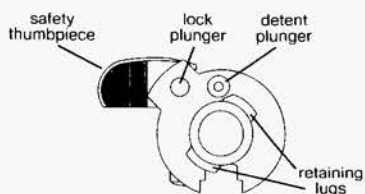
Recoil is taken by a thick, but narrow, lug soldered underneath the receiver ring. Except for this single protrusion, the receiver is a pure tube, with an abruptness of form and lack of contouring which renders a somewhat "squatty" overall aspect to the action.

The diameter of the bolt (.75 inch) is almost equal to that of some of the so-called "full-diameter" types. The extra metal which results in the bolt shell is intended to minimize compression during firing. But because it locks almost five inches behind the base of the cartridge being fired, the added cross-sectional area has little practical benefit. The same applies to the heavy receiver walls. Total "stretch" in the Model 54J is about .001 inch per 1,000 pounds of cartridge backthrust, roughly the same as the rear-locked Remington Model 788, and about five times that of a good front-locked action. This stems from fundamental engineering principles — factors which don't yield to any really practical material or dimensional solution.

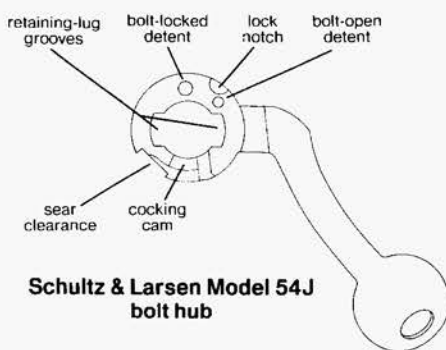
After being roughed out from steel barstock, the bolt body is hardened and ground to final dimension. A cast bolt handle is then welded directly to the rear hub of the bolt.

Schultz & Larsen Model 54J

A cylindrical bolt sleeve, overhanging the receiver at the rear, attaches to the bolt by means of dual lugs. In addition to providing good strength, these lugs simplify field stripping considerably in comparison to the more usual threaded attachment. When the bolt assembly is unlocked from the breech and drawn to the rear, a spring plunger housed in the bolt sleeve snaps forward into a recess in the rear rim of the bolt to index the two parts together. A second recess, spaced exactly fifty-two degrees away on the bolt rim circumference, causes this plunger to also detent the bolt from rotating after it has been turned down into the fully locked position. This both accurately positions the locking lugs on their seats and helps guard against misfires from a partially lifted bolt handle.



**Schultz & Larsen Model 54J
bolt sleeve
(front view)**



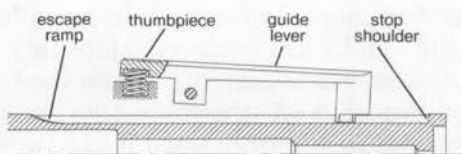
**Schultz & Larsen Model 54J
bolt hub**

Not only is the locking system located behind the magazine, but it is patterned in a unique four-lug array. Thus Schultz & Larsen went perhaps a step further than the three-lug circumferential arrays that became popular in many subsequent multiple-lug rifles. This Danish array of locking lugs has in fact been exceeded only by the five-lug DuBiel, a limited-production rifle made in Sherman, Texas, since the mid-1970s.

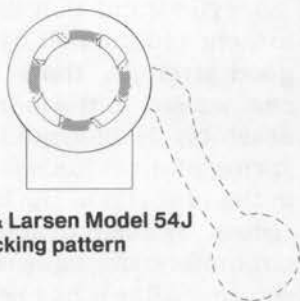
Bolt rotation is not forty-five degrees. Four lugs do not automatically render a one-eighth turn rotation, any more than three lugs require sixty degrees of rotation. To optimize available bearing and camming strengths, the Model 54J bolt in fact turns a little over fifty degrees, or almost the same as the Weatherby Mark V. Study of the Schultz & Larsen locking system reveals some very careful engineering. Each bolt lug moves just past its receiver cam on bolt closure, yet without wasteful over-rotation or overlap.

Aside from gaining a short bolt rotation, a symmetrical lug array has the advantage of helping to stabilize a rear-locked bolt on firing. The long bolt column forward of the locking lugs also receives extra stabilizing support by virtue of the unusually close and even fit

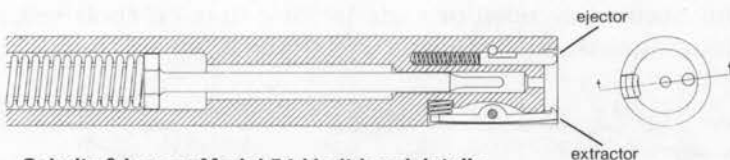
Schultz & Larsen Model 54J



Schultz & Larsen Model 54J
combination bolt guide and stop

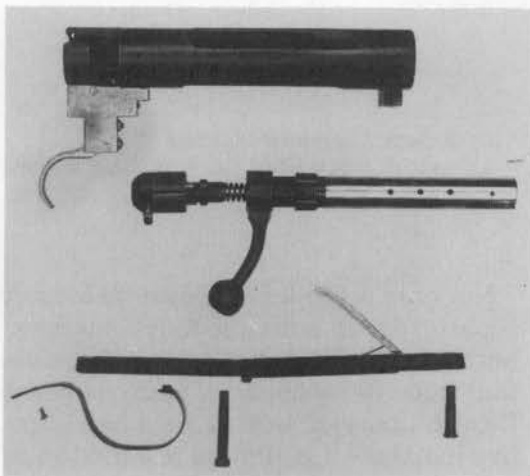


Schultz & Larsen Model 54J
locking pattern



Schultz & Larsen Model 54J bolt-head details

Receiver is tube-like part with a soldered-on recoil lug. Magazine essentially consists of a "finger," spring-loaded up from the floorplate. There is no magazine housing per se, the inner walls of the stock performing that function.



between the bolt body and the receiver, and the fact that the openings in the receiver walls milled out for the magazine and ejection ports are minimal sized.

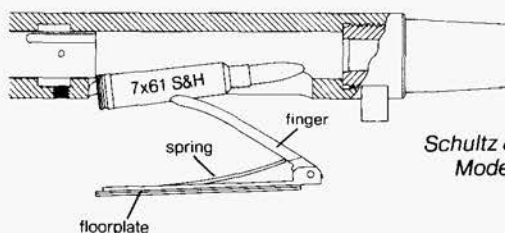
The rear locking lugs leave their short receiver raceways almost as soon as the unlocked bolt begins moving back, and thus a spring-actuated lever pivoted into the left wall of the receiver does the actual guiding. Engaging a long lengthwise groove milled into the bolt body, it supports movement of the bolt assembly in a very uniform and steady manner, without the discontinuities often found in bolts which rely upon their locking lugs alone for guiding. This lever also doubles as a bolt stop, operated for release by a grooved thumb projection at the left rear corner of the receiver.

Schultz & Larsen Model 54J

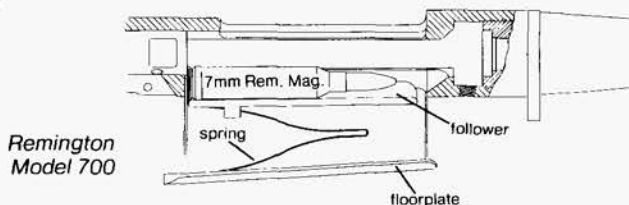
The extractor is a narrow steel lever recessed into the side of the bolt head. Pivoting on a pin and urged inward by a small coil spring, its claw is just under 2/10 of an inch wide. It thus grips barely one-eighth of the rim's circumference when extracting a fired cartridge. Recessed on the opposite side of the bolt face is a spring-powered pin-type ejector.

The Model 54J doesn't use a conventional Mauser double column magazine system — or even a conventional single-column variety for that matter. Instead, it has a very peculiar arrangement which more resembles some early non-Mauser systems found in rifles such as the German Commission Model 88 and the Italian Carcano.

To start with, the lack of locking cavities in the Model 54J receiver ring places the magazine and barrel unaccustomedly close together, and consequently bullets must rise on a very steep angle during the feed cycle. Thus, instead of storing the cartridges horizontally, and depending on a feed ramp to angle them up into the chamber as they strip forward, Uffe Larsen prepositioned them on a slope inside the magazine.



Schultz & Larsen
Model 54J



Remington
Model 700

Comparison of Magazine Feed Systems

While on paper this may sound like a perfectly rational system, in fact unlike a Mauser magazine, the top cartridge lacks the necessary top and bottom support along its length. It tends instead to simply balance or "pivot" between the receiver rails above and a magazine "finger" below. Also, due to the angle of each cartridge, the nose of the forward-moving bolt catches relatively little of its rim. This "teeter-totter" system thus leaves the magazine prone to

Schultz & Larsen Model 54J

jamming. Cartridges easily tip out of position, their rims dipping underneath the bolt as it attempts to strip them forward.

The floorplate frame is a steel slab, with a bend near the middle which gives the overall assembled rifle something of a potbelly appearance. As if that weren't bad enough, a separate sheet metal trigger bow of rather ornamental design threads onto the rear of this floorplate frame, a construction which in this country is typical of only older double-barreled shotguns. The floorplate itself hinges on a cross pin, and is retained at the back by a thumb-operated latch. There are two guard screws, one threading into the recoil lug and the other just forward of the trigger. A small wood screw anchors the rear flange of the trigger bow.

The magazine can neither be charged from above through the receiver port, nor detached for loading. Recharging thus involves turning the rifle upside down, opening the floorplate and clearing away the magazine finger, then dropping cartridges loosely into the cavity formed between the inner walls of the stock and hoping for the best. The system is somewhat reminiscent of that used in the Krag rifle, but it operates with considerably less convenience and certainty.

With a four-quadrant locking-lug array, the Model 54J might very easily have ended up with a grossly underpowered camming setup and a stiff-working bolt. Careful proportioning, however, yielded a reasonably balanced locking and camming relationship. Instead of a forty-five degree bolt lift, it actually rotates fifty-two degrees, the extra seven degrees being put to good use for camming purposes.

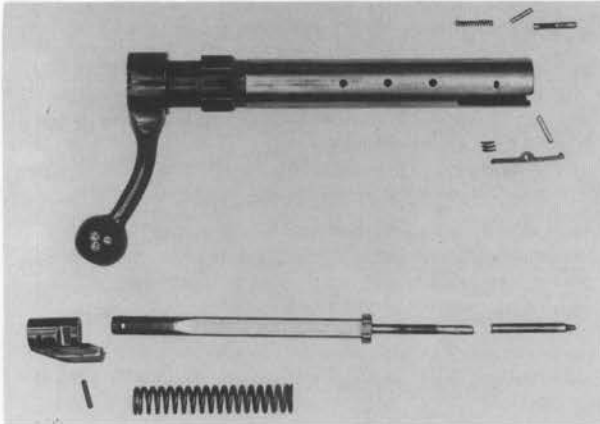
Cam-forward displacement on bolt turndown is in fact sufficient to fully engage the extractor, avoiding the annoying closing "hesitation" common to so many "multiple-lug" rifles. About the only real weak point, particularly from the viewpoint of most American shooters, is a "cock-on-closing" arrangement for compression of the mainspring. A resistance of approximately fifteen pounds is encountered in pressing the bolt forward before the bolt handle can even begin to be lowered. While most of this is accounted for by the mainspring, a small portion (about 2-1/2 pounds) is also contributed by the bolt guide lever as it rides out of its groove during bolt closure.

In order to allow thicker walls near the nose of the bolt, and thus limit its compression during firing, the mainspring flange on the firing pin is located well to the rear. This also, however, limits mainspring length. Accordingly, the mainspring is wound on a

Schultz & Larsen Model 54J



Comparison with later Model 68DL (above) illustrates limited room allowed for Model 54J mainspring (below).



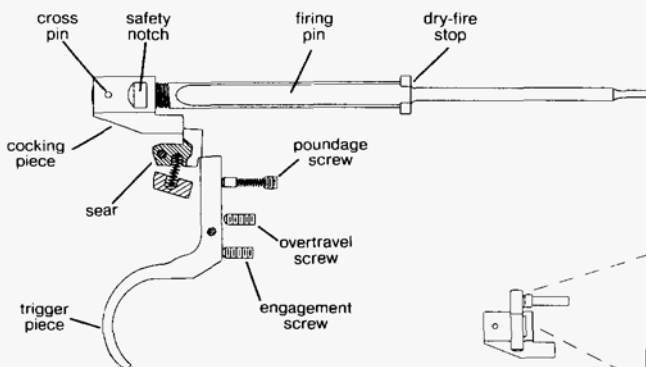
Model 54J bolt has triple in-line gas ports as later found in Weatherby Mark V. Firing pin in this particular specimen is obviously due some repair work.

rather large diameter, causing the remainder of the bolt to be bored out more than would otherwise be necessary, and somewhat undoing the extra stiffness achieved near its head.

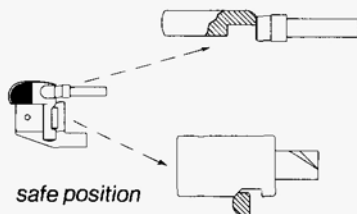
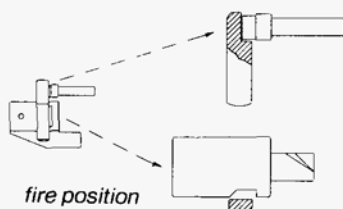
The firing pin tip ends up almost long and thin enough to resemble an old "needle-gun" arrangement. Behind the mainspring flange, deep flats milled into each side of the shaft trim the firing pin's weight down to under two ounces. Nonetheless, a very ineffective mainspring renders an almost five-millisecond lock time, slow even considering the fact that this rifle was designed thirty years ago.

The cocking piece, threaded to the rear of the firing pin, is notched on its right side. The angled rear face of this notch cooperates with the spindle of a two-position safety pivoted vertically into the right side of the bolt sleeve. When the thumbpiece of this safety is turned outward, a slot in its spindle clears the cocking piece to allow firing pin movement. Turned back ninety degrees, its full circumference enters the notch in the side of the cocking piece, camming

Schultz & Larsen Model 54J



**Schultz & Larsen Model 54J
firing unit**



**Schultz & Larsen Model 54J
operation of safety**

the firing pin assembly back several thousandths of an inch. This not only frees the sear underneath, but the rotating movement simultaneously cams a plunger in the bolt sleeve forward to lock the bolt in the closed position.

The trigger is a basic override pattern. Its sear is a small L-shaped lever, supported against mainspring pressure by the trigger piece underneath. Both parts pivot within a sturdy machined-steel housing. Full adjustments for the trigger (engagement, poundage and overtravel) are provided by screws threaded into the front wall of the trigger housing just forward of the trigger piece.

The spring beneath the sear is on the weak side, so weak in fact that rearward pressure from the trigger piece can jam the sear from rising if the poundage spring adjustment is set a little too high. Too little poundage, on the other hand, can fail to move the trigger piece back under the sear as the rifle is cocking. Thus, adjustment of the poundage spring becomes overly critical to functioning, a situation which a better sear spring arrangement would have avoided.

Summary

The Model 54J was one of the earliest, and actually most radical, commercial departures from the dominant Mauser theme in bolt actions. It is a study of contradictions. While exceptionally strong, its rear lugs fail to give rigid lockup. In contrast to most American arms, it is made better than it is engineered, and an enormous amount of manufacturing skill was lavished on a design of basically limited potential. One can only contemplate the result of that much skill and craftsmanship devoted to a top U.S. rifle design.

The following summarizes the strong and weak points of the Model 54J action:

Strong points:

1. Strong breeching and gas handling.
2. Deep barrel tenon.
3. Strong locking lugs and receiver ring.
4. Rigid and easily bedded receiver.
5. Short bolt travel.
6. Fully adjustable trigger.
7. Direct-acting safety.
8. Bolt handle detent.

Weak points:

1. Cock-on-closing.
2. Rear locking.
3. Bent-metal trigger bow.
4. Angled floorplate frame.
5. Jam-prone magazine system.
6. Difficult-to-load magazine system.
7. Slow lock time.
8. Lack of override bevel on bolt stop.

Schultz & Larsen M54J Dimensions

OPERATING

Extraction: set-back — .09 in.

leverage — 7.5 to 1

Chambering: cam-forward — .10 in.

leverage — 7.5 to 1

Bolt rotation — 52°

Bolt travel — 3.86 in.

Schultz & Larsen Model 54J

Cock-on-closing: .399 in.
mainspring compression
proportioned as follows:
 opening — .162 in.
 press-forward — .137 in.
 closing — .100 in.

IGNITION

Firing pin travel: at impact — .339 in.
 dry-fired — .399 in.

Lock time — 4.5 ms.

Impact velocity — 12.7 ft./sec.
 energy — 56.7 in.-oz.
 impulse — .74 oz.-sec.

Striker/firing-pin hole diameters — .083 in./ .085 in.

RECEIVER

Overall length — 7.47 in.

Length of loading/ejection port — 3.74 in.

Ring/bridge diameter — 1.330 in.

Barrel threads — 26x1.8 (metric)

Recoil-lug bearing area — .41 sq. in.

Guard screws (metric) — M6x1

Scope-mounting screws — 6x48

BOLT

Lug shear area — .581 sq. in.

Lug bearing area — .093 sq. in.

Bolt diameter — .748 in.

Lug undercut diameter — .725 in.

Lug diameter — .941 in.

Bolt-face counterbore — .112 in.

Schultz & Larsen Model 54J

MAGAZINE

Length — 3.52 in.

Capacity — 3

WEIGHT

Receiver group	25.1 oz.
Bolt group	14.5 oz.
Magazine/floorplate group	7.5 oz.
Total action weight	47.1 oz.

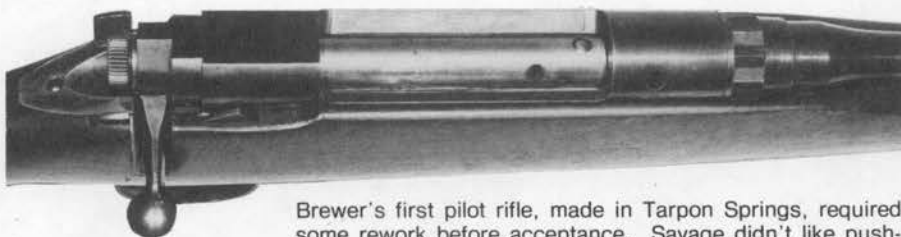
Savage Model 110



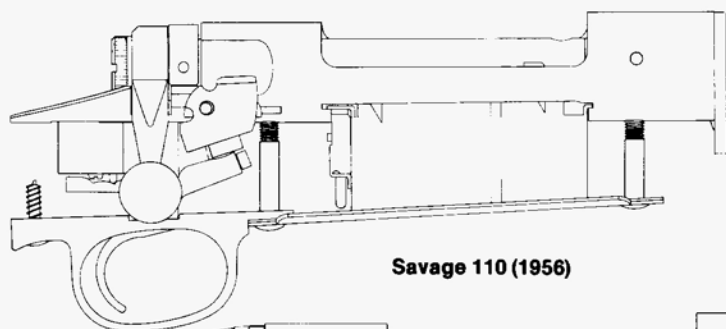
By the mid-1950s, a really topflight centerfire bolt action rifle had been conspicuously absent from Savage's product line for almost three decades. While it is true that the discontinued Model 1920 rifle had been replaced with a Model 40, 45, and then 340, these simply weren't the kind of arms that interested serious riflemen. Meanwhile, Winchester was back on track with postwar production of the Model 70, while Remington was setting sales records with the newly-developed 721/722 rifles.

Thus in March 1955, Savage dispatched one of its vice presidents to Tarpon Springs, Florida, to offer Nicholas Brewer the job of designing a new bolt action. Even though he wasn't a payroll employee, Brewer was considered the logical choice for such a project as his ties with the Savage organization went back many years. He was at Stevens from 1929 to 1938, then headed up production of the Browning machine gun for Savage at Utica during the war.

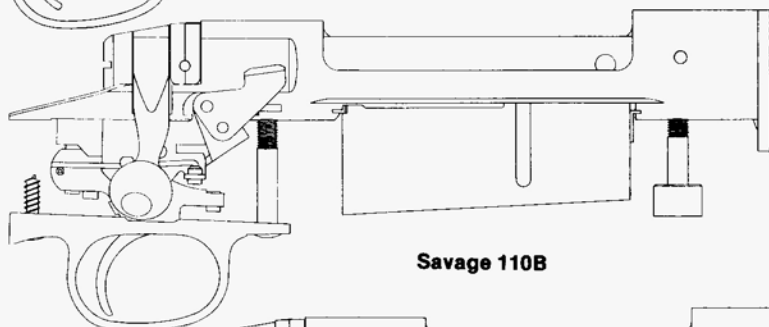
While Brewer's health cut short his career in 1942, he remained as active as possible in retirement as a gun designer, doing consultant work for a variety of companies. The Savage 340, introduced in 1950, was in fact his design. Brewer thus did not hesitate to accept the new assignment, quickly setting to work on the rifle. Enlisting the help of several gunsmiths in the Tarpon Springs area for the actual machine work, he had a working prototype built by the end of the year.



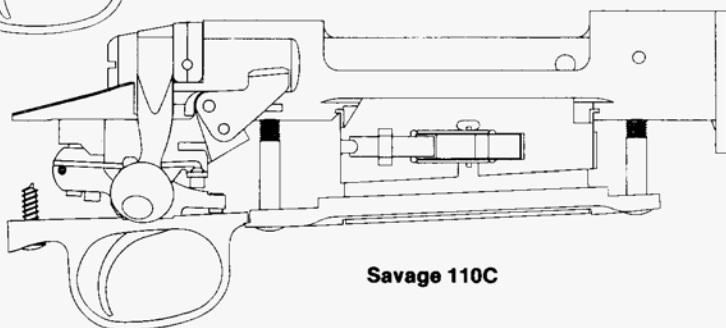
Brewer's first pilot rifle, made in Tarpon Springs, required some rework before acceptance. Savage didn't like push-button safety and multi-faceted barrel nut. Also redone was sear thumbpiece in front of bolt handle and the gas porting arrangement.



Savage 110 (1956)



Savage 110B



Savage 110C

In January 1956, Brewer brought this first prototype up to Chicopee Falls for evaluation. While it received generally favorable comment, Savage wanted some areas changed. After delaying just a few days to allow the factory to make some of the more difficult cuts on a second set of raw blanks, Brewer returned to Florida to build another prototype. This second pilot, which he had back up north by May, ended up very similar to the first production rifles. Five pilot rifles in .30-06 caliber were then built for testing and customer acceptance purposes. They were made at Chicopee Falls under the direction of Ed Stark, who was in charge of tooling up for the new rifle at the factory. About the time these rifles were undergoing final tests, in December 1956, Brewer succumbed to the cancer that had so long plagued him, never actually getting to see his final design in production.

Nick Brewer and Ed Stark (later Savage's Chief Engineer) had collaborated very closely. Considering the relative complexity of the

Savage Model 110

rifle, plus the fact that Brewer was working more than a thousand miles away in Florida, things proceeded with remarkable speed and efficiency. Brewer's drawings and calculations proved so accurate and complete, that few revisions were needed during tool development.

Introduced in early 1958, the action of the rifle remained essentially unchanged for several years. The only major redesign since that time was initiated in 1964 by a marketing department request for a detachable-magazine version. The project fell to Bob Greenleaf, an engineer and benchrest shooter who had come all the way from Colorado to work for Savage, and was subsequently rewarded by inheriting full engineering responsibility for the rifle. While Greenleaf started off by adapting the new magazine, he soon found himself retooling many other areas of the action, and consequently rifles made after 1966 represent a distinct second generation of the 110. The only other significant change to date was the incorporation of a special bolt guide system in 1972.

The 1958 rifles, chambered in .30-06 and .270, carried a \$109.75 price tag, approximately midway between the Remington 721 (\$95.25) and Winchester Model 70 (\$129.95). Later that year, .243 and .308 chamberings were added, using a half-inch shorter action. While it has been written that the 110 designation was based on an original \$110 pricing goal, no one at Savage recalls that. It was, in fact, the "Savage Model 98" throughout its development, a designation abandoned only at the last moment when marketing realized that some confusion might arise due to prior use of that number by a rather widely-travelled German bolt action.

Savage added left-hand models in 1959. Thus, as Brewer had envisioned, the new Savage rifle became the first bolt action ever available in a truly complete line to satisfy every shooter's needs. This also proved to be a rather opportune marketing move. There was such a long-neglected market waiting, that, for a time, sales of the rifle ran almost four to one in favor of the southpaw versions!

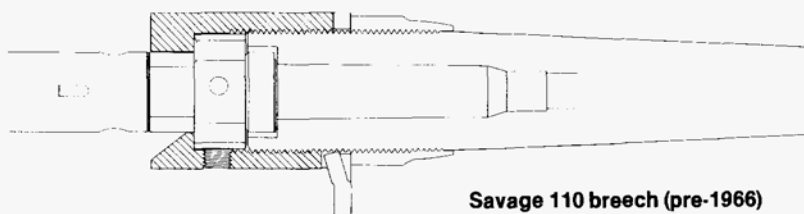
Savage patented many of Brewer's ideas, cramming them into a single application filed November 20, 1958. Four patents were ultimately issued, each covering a specific aspect of the 110's design:

<i>Patent no.</i>	<i>issue date</i>	<i>subject</i>
3,005,279	Oct. 24, 1961	bolt assembly
3,103,757	Sept. 17, 1963	ejector
3,106,033	Oct. 8, 1963	sear
3,138,888	June 30, 1964	safety lock

Brewer had an exceptional grasp of arms tooling and production,

Savage Model 110

and his rifle featured manufacturing economy and ease of assembly to a hitherto unknown degree. It allowed lowering costs without simply resorting to cheaper materials or cruder workmanship. Some features were carried over from his earlier work, but more were entirely new. Gas leakage within the receiver was blocked by two heavy "baffles" rotating on the bolt body. A shoulderless barrel was locked to the front of the cylindrical receiver by means of a spanner-wrench locknut, which also held the recoil lug. A multipiece bolt was threaded and pinned together. Inside, an array of small stampings and screw machine parts made up the firing pin, whose movement was controlled by an adjustable trigger in the right raceway, plus a three-position safety on the rear tang. Pressed into the magazine were special bullet-protecting ridges, developed at Savage well before Brewer's time, and later combined with a very effective push-button detachment system for the Savage 110 C.



Savage 110 breech (pre-1966)

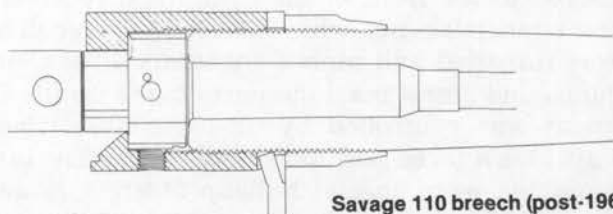
Brewer's locking lugs were set back about a quarter-inch from the bolt rim, leaving a protruding nose to enter the barrel like Remington's 721/722. It was not, however, a solid continuous ring. Since Remington had patented their little internal snap ring extractor in 1949, Brewer fit his on the outside. This not only forfeited the solid bolt nose, but required a barrel counterbore cut a tenth-inch oversize for extractor expansion. Thus, Brewer couldn't hope to back up the chamber with any kind of seal as Remington had.

He did, however, include other schemes to control escaping gas, including baffle rings, multiple gas ports, and a solid bolt cap. An intricate system of baffles and vents, layed out in exacting detail in Patent no. 3,005,279, is impressive on paper. Yet it tends to entrap escaping gas inside the receiver ring, where interior diameters are relatively large and thus vulnerable, rather than block it off at the chamber. Prior to 1972 this may have been a largely academic concern for the 110, but due to a deep guide groove now broached into its interior, broken receiver rings are no longer an unknown phenomenon.

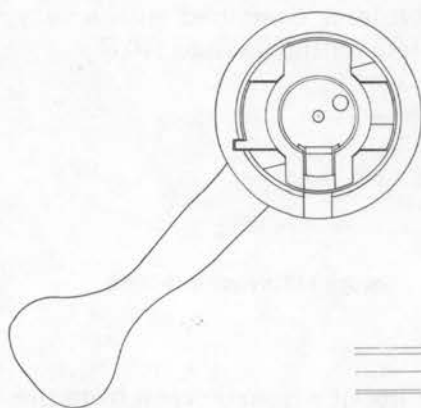
The breech was repatterned in 1966 to more closely resemble that

Savage Model 110

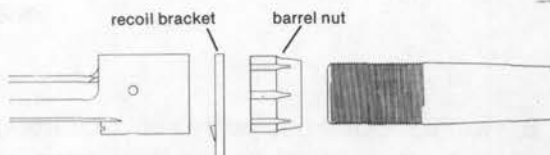
used in Winchester Model 70 rifles. Besides a new extractor and ejector, the locking lugs were brought flush with the bolt rim, eliminating the counterbore in the barrel. The cartridge head is not only better encircled in this new arrangement, but it can seat deeper into the barrel due to the more compact extractor.



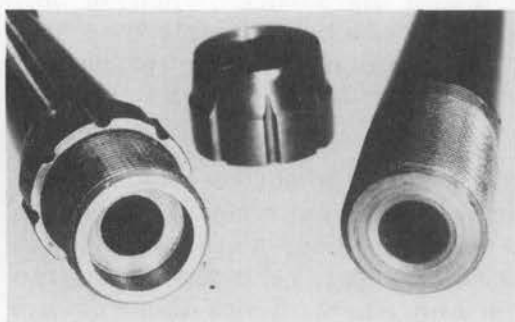
Savage 110 breech (post-1966)



Savage 110 (post-1972)
front view



Savage 110
barrel attachment

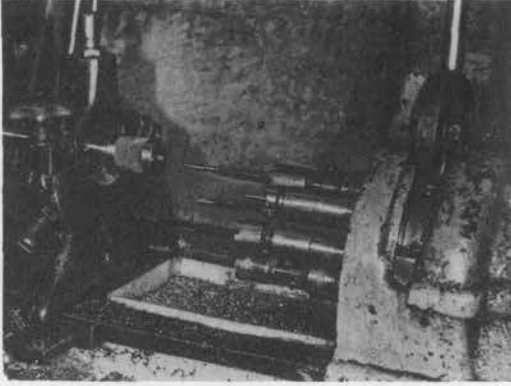


While all 110 barrels use lock nut system, prior to 1966 they were also counterbored (left). Clearance for bolt nose was so great, however, that counterbore had little functional significance.

Otherwise, Brewer's gas handling system remained intact as did the method of fitting the barrel. Formed without a shoulder, it is fixed in place by a large threaded locknut, an idea used for the Savage Model 340, and probably originating from Brewer's wartime

Savage Model 110

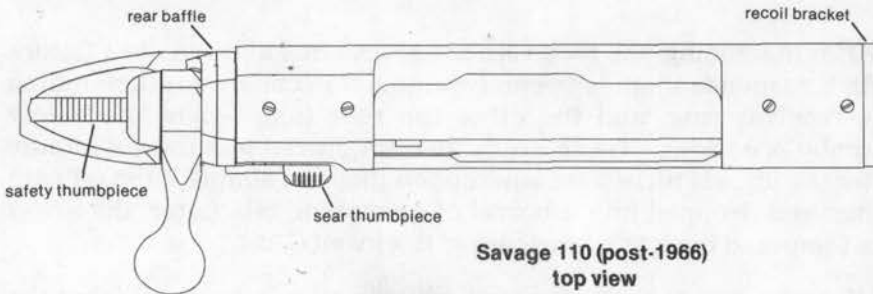
experience with the Browning machine gun. Allowing headspace to be set quickly and precisely upon assembly, Savage has gotten a lot of mileage out of this system for years in their advertising. Aside from some reservations concerning aesthetics, it also has garnered praise from most gun critics, due to the rather compelling technical logic of directly headspacing a barrel in this manner.



Each barrel is final chambered prior to fitting it to action. Bushing on end of barrel controls depth of each cut.

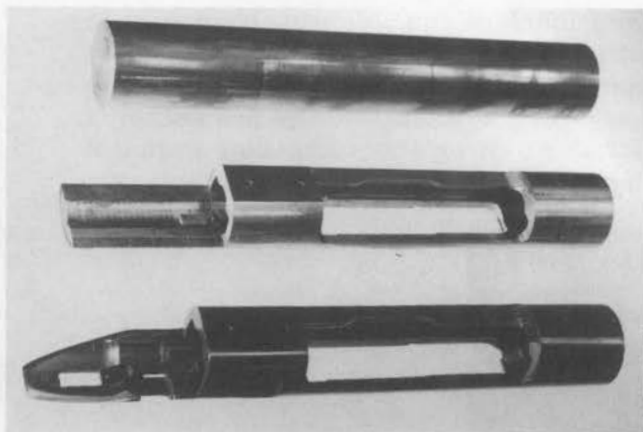
Each prechambered barrel is screwed and locked into place against a "go" assembly gauge. A "no go" gauge is then inserted to make sure the bolt won't close. These "assembly," or "swing" gauges as Savage calls them, look just like headspace gauges, but are exactly .002 inch shorter, the amount the barrel threads seat when the newly-assembled 110 rifles are proofed. Following proof firing, each rifle is rechecked with a set of true headspace gauges.

The receiver is a cylindrical pattern, machined from AISI-4130 barstock. A bracket-type recoil lug is clamped to the front during assembly of the barrel. Even though Savage moved from the old Chicopee Falls location, which they had inherited from Stevens, to the new Westfield factory in 1960, much of the 110's production remains slow and unautomated. Machine work on the receiver comprises long rows of small, single-operation tools, with the parts moved from station to station on handcarts.

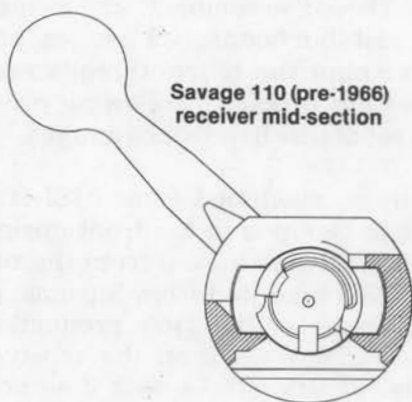
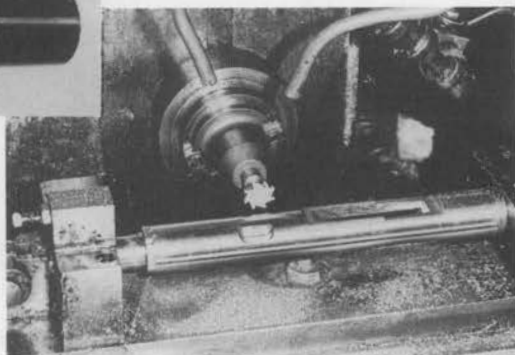


Savage 110 (post-1966)
top view

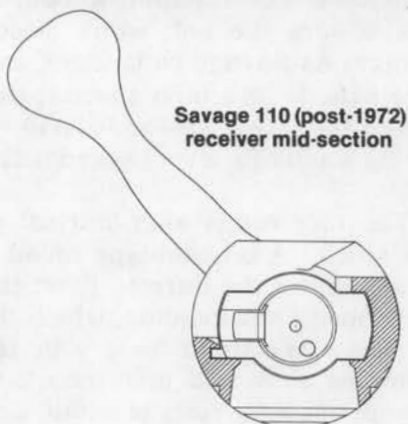
Savage Model 110



Each 110 receiver is machined from pre-cut blank of alloy steel (above), in a long process involving mostly isolated single-operation machine tools (right).



Savage 110 (pre-1966)
receiver mid-section



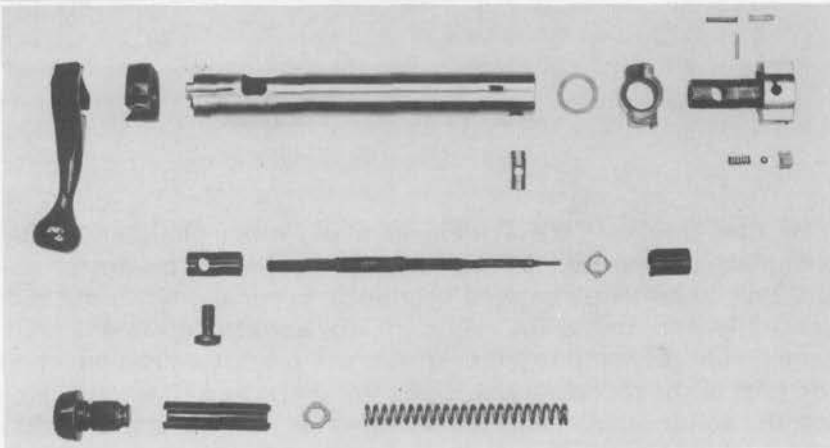
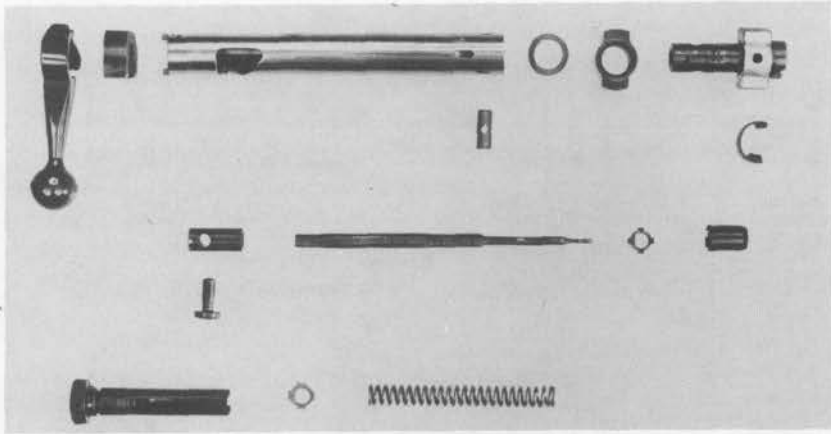
Savage 110 (post-1972)
receiver mid-section

After machining, the receivers are placed one at a time in a fixture which suspends them between two induction coils, one surrounding the receiver ring, and the other the rear tang where the safety thumbpiece slides. These areas turn bright red less than a minute after the juice is turned on, whereupon they are simply lifted off with tongs and dropped into a barrel of quenching oil. Later, the areas are tempered back to a hardness of Rockwell C 32-37.

Whereas one of Paul Mauser's contributions was simplifying the

Savage Model 110

bolt to the form with which we are now most familiar, Brewer headed in the opposite direction by forming the 110 bolt from a conglomerate of stampings and screw-machine parts. The body is a heavy-walled cylinder cut from low-carbon steel barstock. It is machined and punched in various places to accommodate the parts attaching to it, then carburized and polished to yield a very hard and smooth-running outer surface.

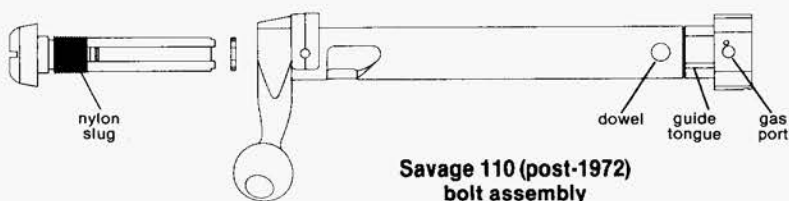
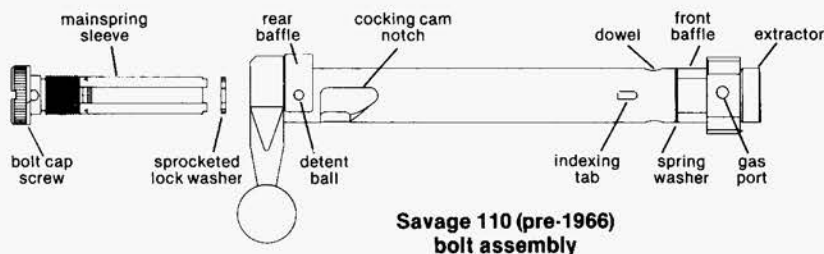


Original 110 (above) and post-1966 (below) bolt assemblies constitute a remarkable conglomeration of parts. Rotatable gas baffles block escaping gas, and a small "bolt cap screw" effectively shrouds rear of bolt. Forward-located sear permits a short, light firing pin. A Savage ad boasted that this bolt had "only 18 parts." It would be difficult to find a production-rifle bolt with more.

The bolt head, machined from blanks of AISI-4135 alloy, is necked down at the back to fit into the bolt body, where it is fixed by a sturdy cross dowel. Sandwiched in between is a heavy baffle ring, plus a spring washer which presses it forward against the locking lugs to maintain alignment.

Savage Model 110

At the back, a slotted-head screw threads into the rear of the bolt body to clamp the bolt handle and to provide rear purchase for the "mainspring sleeve," a rolled sheet metal tube which reaches inside the bolt to support the mainspring. This arrangement allows the "bolt cap screw" to remain fixed in the bolt body, thus eliminating thread friction and wear as the bolt opens and closes.



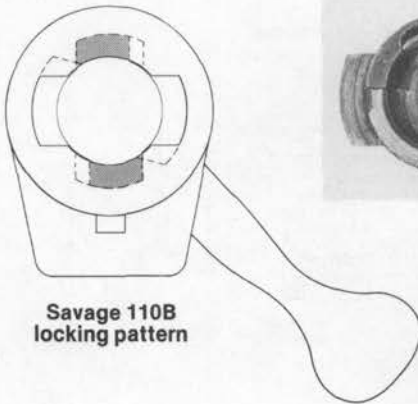
Besides the bolt face, Greenleaf made other changes to the bolt assembly during his 1964-66 redesign project. The dowel holding the bolt head in place was originally vertical. Not only did this resemble the breathing hole of an aquatic mammal, but the punched-in indexing tab ninety degrees from it stared out the loading port of the receiver. The whole thing just looked wrong. By shifting the setup ninety degrees, the dowel is now horizontal, while the punched-in tab is hidden down inside the magazine.

There were also changes at the rear of the assembly. The bolt handle knob was made pear-shaped and swept slightly back, while the bolt cap screw was streamlined, and its ball bearing detent arrangement was replaced by a simple nylon slug sunk into the threads.

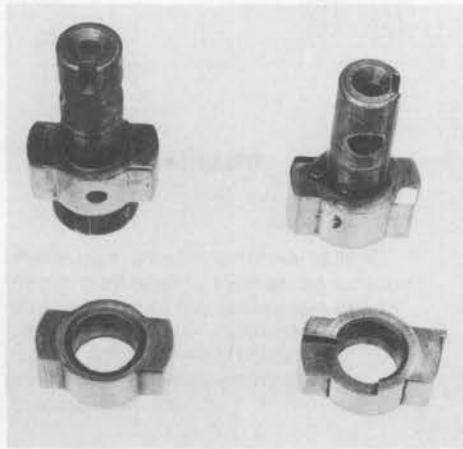
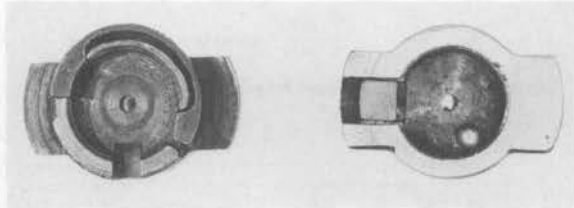
Brewer's 110 bolt was guided by its locking lugs alone. While this originally worked reasonably well, through the years control of tolerances and finishes didn't keep pace. By the late 1960s the 110 bolts had so much play and slop in their raceways that they had to

Savage Model 110

be worked very gingerly to avoid jamming. If operated rapidly with heavy pressure on the handle, the bolt could easily freeze solid coming back out of the receiver ring, as well as when first started forward on the closing cycle.



**Savage 110B
locking pattern**

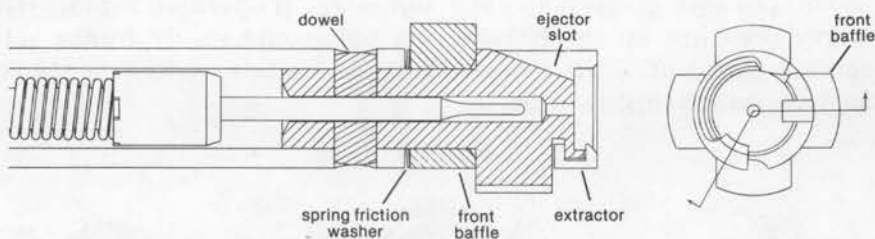


Bolt head was revamped in 1966. Band extractor and slotted ejector (above left) gave way to a sliding-plate extractor and pin ejector (above right). Cross hole in neck of bolt head was shifted 90 degrees to improve appearance (below right). In 1972, a keyway guide system also gave smoother bolt movement.

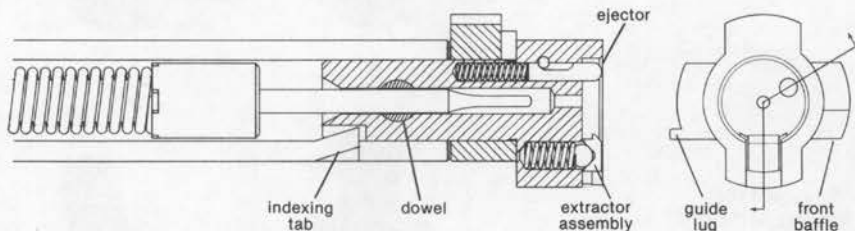
Thus, in 1972 a special groove was broached inside the receiver to form a keyway guide system (U.S. Patent no. 3,710,492 issued January 16, 1973 [F. Tirrell]). It closely resembles an earlier Husqvarna arrangement (U.S. Patent no. 3,416,253), except to avoid patent infringement, Savage's guide tongue protrudes from the baffle lug, rather than from the right locking lug itself. The baffle is in turn now interlocked to the bolt at full lift by a small, hardened pin pressed into the right locking lug. Named the "Satinslide Bolt," this eliminated the binding which had crept into the 110 rifle over the years. On opening, there is virtually no jump or discontinuity as the keyway-guided bolt head emerges from the receiver ring, and it is controlled so closely and evenly that the handle may be maligned as vigorously as desired without fear of jamming.

Brewer's extractor was a hardened and tempered investment casting, with retaining lugs on each end to engage undercuts milled into the bolt head. This circular part was strong, but relatively

Savage Model 110

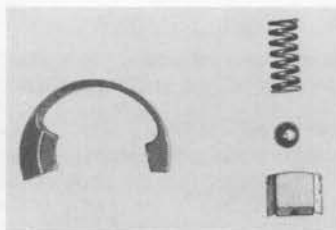


Savage 110 (pre-1966) bolt-head details



Savage 110 (post-1972) bolt-head details

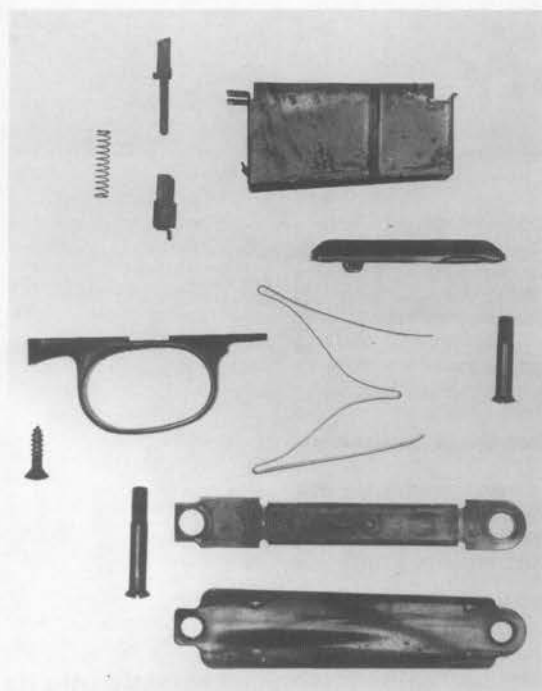
Original investment-cast extractor (left) was more expensive to make than current three-piece assembly (right). While the new extractor was designed with a curved claw to fit the cartridge groove, its geometry was simplified during tool development.



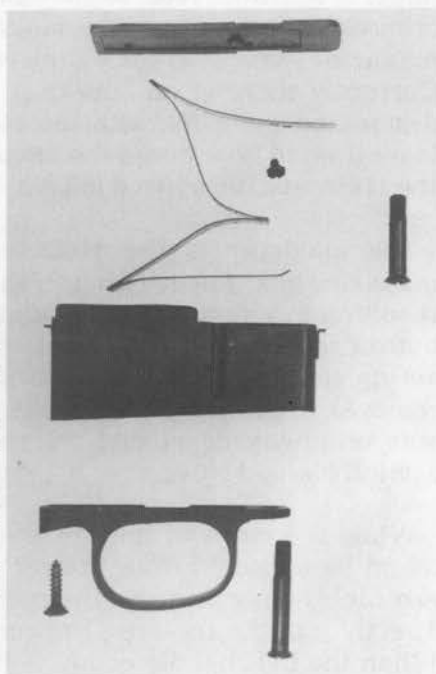
expensive to produce. When Savage economized by switching to a punch press version in 1962, strength suffered. Breakage became a problem due to slight variations in heat treatment between various lots of parts. Thus, in 1966, Greenleaf abandoned that type of extractor completely, substituting a simple sliding-plate type similar to that used in several of Winchester's high-power rifles. This not only functioned more reliably, but it improved the breech by leaving more of the bolt head circumference intact, and by allowing the cartridge to seat deeper into the barrel.

Cast from beryllium copper, the new extractors are not only easy to make, but can't rust or stick within the steel bolt head. They slide in a T-slot milled across the right locking lug and are resiliently positioned by a simple spring-loaded ball, a construction which tends to further reduce any sticking or jamming tendencies. The ejector was also revised. Brewer used a blade mounted vertically from the back wall of the magazine box. The later detachable magazine, however, forced a change, and a simple spring-loaded pin was placed inside the bolt face.

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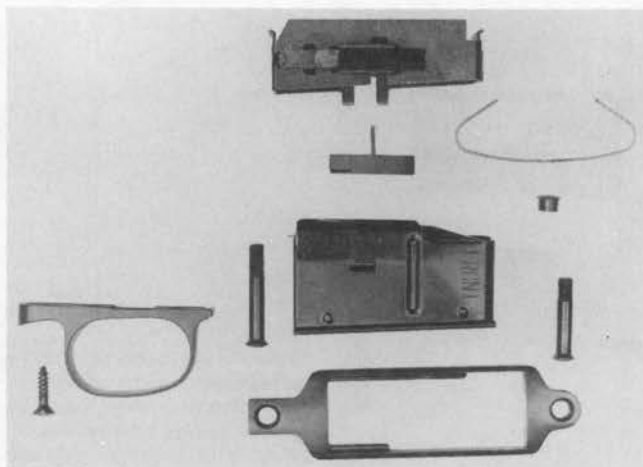


Brewer's magazine assembly was a masterwork of the tinsmith's art, with even a sheet metal follower piece. Interlocking relationship between magazine, receiver, and ejector housing was patented. So was vertical crimp to protect bullet points, but many decades earlier back when the Savage Model 1920 rifle (chapter 2) was being developed.



Model 110B has rudimentary magazine, closed underneath by the floor of the stock. Ribbon spring is attached to black plastic follower piece by a small self-tapping screw. Both guard/screws on all 110 rifles are forward of the trigger, with a wood screw used to hold up things at the back.

Savage Model 110



110C detachable magazine system includes a sheet-metal framework tabbed into receiver and die-cast aluminum floorplate frame inletted into the stock. A long loop spring "ejects" the self-contained magazine box downward for easy removal.

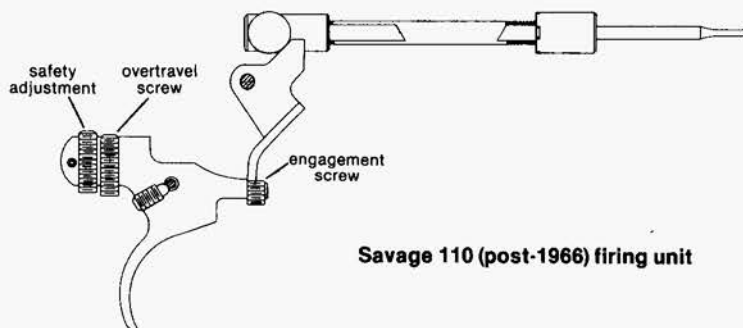
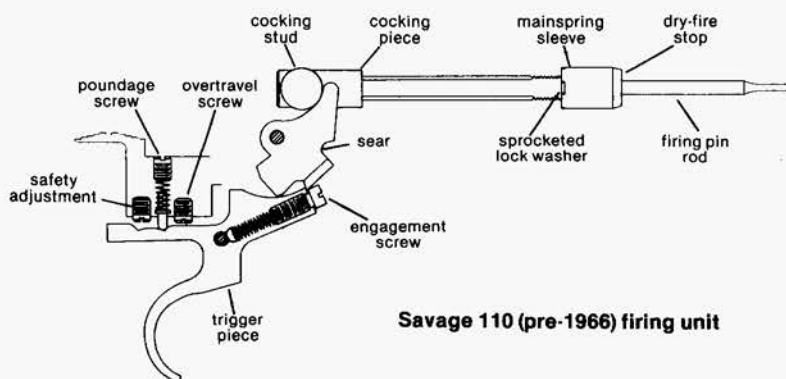
Brewer's receiver had cartridge guide lips milled directly into its underside. After 1966, to save money, these surfaces were instead crimped into the top of the magazine box. There have been three magazine variations since Brewer's original fixed-floorplate version. Currently there is an "internal" magazine version, until recently designated the 110B, with the stock routed only partway down to leave a wood floor under the magazine. A hinged-floorplate version, the 110D, was introduced in 1973, but lasted only a couple of years.

The mainstay is the 110C, with a detachable double-column magazine box. Pushed up fully into place, it lies flush with the stock, resulting in a very attractive and practical system. When a release button recessed into the right wall of the stock is pressed, a wire spring ejects the magazine downward, allowing quick and positive removal, even with gloved hands. This patented magazine "ejector" was originally developed for the Model 99 rifle (U.S. Patent no. 3,281,979 issued November 1, 1966 [E. Stark]).

While the cams in the 110 are conventional in performance, as might be expected from Brewer some details of their construction are highly unorthodox. Instead of machining an extraction cam directly into the receiver, Brewer used the non-turning rear baffle. When the bolt handle contacts its wedgelike slope, this baffle can neither turn nor move forward. The bolt is thus forced rearward to pull the fired cartridge free of the chamber. Also during bolt

Savage Model 110

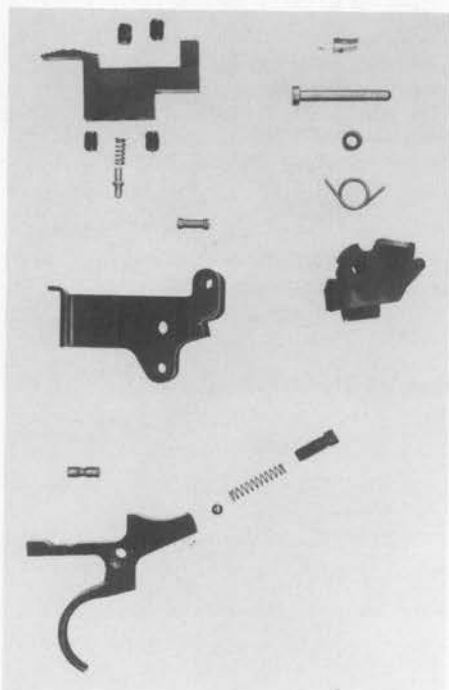
opening, a "window" cam cut into the side of the bolt forces a stud projecting from the cocking piece to slide rearward in the right receiver raceway, compressing the mainspring in the process. Both arrangements saved production costs. Placing the cam angle on the rear baffle simplified machining and heat treatment of the receiver, while indexing the cocking piece in a pre-existing raceway was obviously cheaper than milling a special groove in the receiver floor for that purpose.



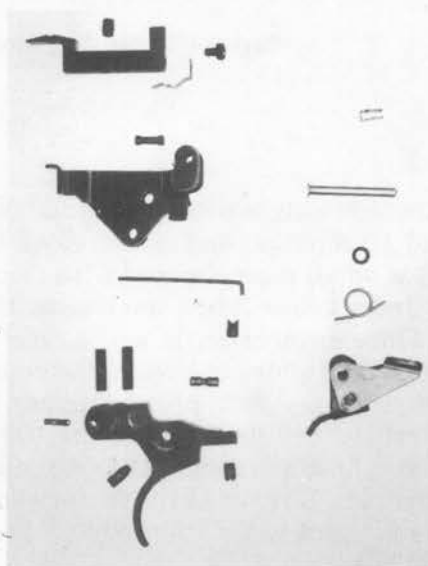
Brewer's firing pin assembly is a case study in how to utilize screw-machine parts and stampings, and avoid close tolerancing. The firing pin is simply a small diameter rod with flats milled along its sides. A threaded front collar forms the mainspring purchase and dry-fire surface. Once protrusion is set, a four-sprocket washer keyed to the firing pin rod slides in behind the collar to keep it from turning. With 28 threads per inch, protrusion can be adjusted to its "print" range (currently .050 to .065 inch) in .009 inch increments upon assembly. The cylindrical cocking piece similarly threads onto the rear of the firing pin. It is set at the factory so that the cocking stud lies essentially tangent to the front edge of the cam window for maximum firing pin fall.

Savage Model 110

The sheet metal sleeve encircling the cocking piece projects forward to interlock with a second sprocketed washer keyed to the firing pin rod directly behind the mainspring. Since this mainspring sleeve is aligned to the cocking stud, the entire firing pin assembly is prevented from turning as the bolt is opened and closed.



While Brewer's original trigger/safety assembly (above) and Greenleaf's improved version (below) function essentially the same, many details changed. The trigger piece, formerly cut from steel plate and swaged in a punch press to form the finger curve, is now powder metal. It is tensioned by an L-shaped wire, in place of previous coil spring and plunger. The new sear is reportioned for lighter contact with the trigger piece, plus cleaner release of firing pin.



Savage Model 110

Brewer's trigger has a sear pivoted directly in the receiver, and biased counterclockwise by a stout torsion spring. A complexly shaped part blanked and folded from steel plate, this sear has one arm projecting up into the receiver raceway to control the firing pin assembly, another forming a thumbpiece outboard of the receiver, and a third to engage the trigger piece pivoted below in the trigger housing.

Patent no. 3,106,033 shows sear engagement controlled by the screw threaded into the front nose of the trigger piece. The further this screw was backed out, the further the sear dropped into the gap formed behind its head. While appearing to be a perfectly good idea, and in fact used that way by many shooters, according to Savage engineers Brewer's trigger actually wasn't intended to adjust for engagement. During assembly at the factory, it was "set" to a .015 inch engagement by the use of screws with a range of four different head diameters. But whichever size screw was chosen, it was then supposed to remain solidly bottomed into the trigger piece, not backed out.

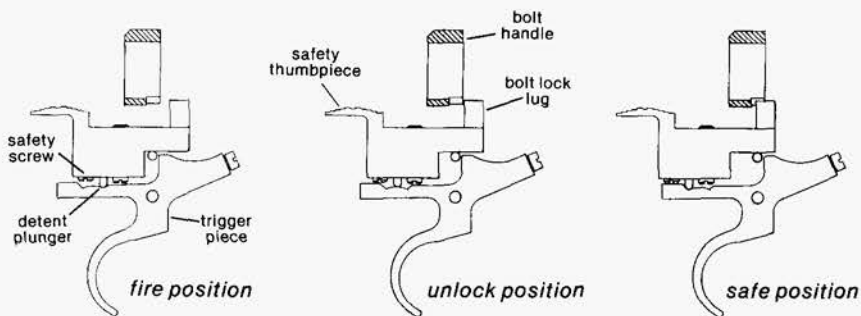
Greenleaf modified the arrangement in 1966, relocating the screw ninety degrees so it works directly underneath the sear to properly control engagement, and thus eliminate the need for a select-fit procedure. Poundage and overtravel are adjustable in both the old and new triggers, although in the original version these screws were hidden up in the safety block, and consequently inaccessible without first removing the trigger. This obviously didn't speed up the assembly line either, and so Greenleaf also relocated these screws, to a more accessible location in the trigger piece itself.

Nylon slugs lock the screws in the trigger assembly. Another nice detail involves the trigger pivot. Rather than simply peening over or staking the ends of this pin, Brewer necked its middle for a spring-loaded ball, allowing it to snap in and out of place. Currently, a small ball-head setscrew is used which operates the same, but must be backed off prior to removing the trigger pin.

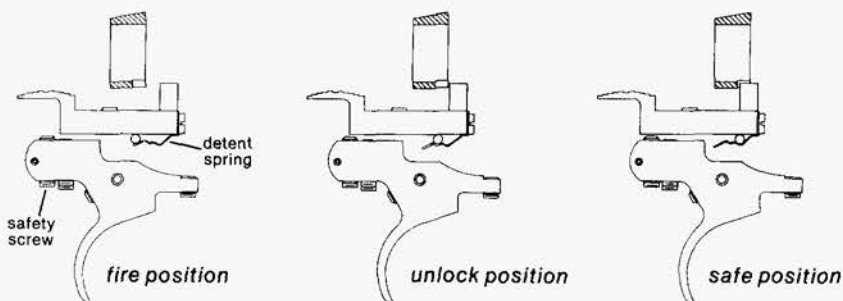
Projecting up into the right raceway, the middle sear arm not only catches the firing pin going forward, but retains the bolt in the receiver by contacting the front baffle on its rearward stroke. To remove the bolt, the sear is "released" by the trigger, then lowered with the thumbpiece just forward of the bolt handle. Since trigger movement doesn't actually lower the sear, this doesn't preclude a normal overtravel stop. The external thumbpiece also serves as the cocking indicator. With the rifle cocked, it has an upward angle, moving down to an almost horizontal position upon firing.

Savage Model 110

The safety is a blocklike part positioned between the receiver tang and the rear flange of the trigger piece. When it is slid forward to *fire*, the trigger has enough clearance to rotate forward and release the sear. Slid backward to *safe*, an adjustable safety screw blocks trigger movement. Simultaneously, the front nose of the safety block enters a notch in the rim of the bolt handle to lock the bolt in place.



Savage 110 (pre-1966) operation of safety and bolt lock



Savage 110 (post-1966) operation of safety and bolt lock

A third "unlock" position is also available. As the thumbpiece slides rearward, the trigger is locked before the bolt handle. Thus, by moving it only partially back, cartridges can be worked through the action with the safety engaged. In the present layout, the ribbon spring used to control the safety has a detent for each position, while Brewer's version was detented only in *fire* and *safe*, and one had to estimate the unlock position.

This "shotgun" style sliding-thumbpiece safety, covered by U.S. Patent no. 3,138,888, is convenient and easy to use. It is well clear of any low-mounted scope, and its position down in the middle of the

Savage Model 110

rear tang is not only equally handy for right and left-hand shooters, but is better protected against branches and limbs than some side-mounted types.

Summary

The action of Nicholas Brewer's 110 rifle is "different" in too many ways to easily yield to a neat summary. While outwardly appearing as a more or less obedient Mauser offspring, and in fact sharing many of its overall virtues, it is constructed in some very novel ways. Brewer worked with a purpose. His changes rendered the action easier to make. It could be manufactured more cheaply than conventional designs having fewer, but more intricate parts. Other rifles have since copied this approach in an attempt to gain a competitive edge in the marketplace, but few can match Brewer's results.

The abundance of small parts in the 110 has proved too much for some purists, even today. Overall, however, the rifle was well accepted, and year after year it has been one of the steadiest sellers in Savage's product line. Not too long ago total sales passed the 200,000 mark. Orders each year usually outstrip the factory's rather limited capacity. This acceptance has been greatly aided by Savage's foresight in offering southpaw models, as well as short and long receivers, pioneering the approach among the major arms companies.

The following summarizes the strong and weak points of the Model 110 action:

Strong points:

1. Strong locking lugs.
2. Good gas-handling system.
3. Solid bolt cap.
4. Fully adjustable trigger.
5. Smooth camming action.
6. Strong recoil-lug layout.

Weak points:

1. Shallow extractor grip.
2. Jam-prone bolt (prior to 1972).
3. Potential for firing pin misadjustment.
4. Trigger-block safety.

Savage Model 110 Dimensions

OPERATING

Extraction: set-back — .08 in.
leverage — 7 to 1

Chambering: cam-forward — .10 in.
leverage — 10 to 1

Bolt rotation — 92 °

Bolt travel: short action — 4.13 in.
long action — 4.68 in.

Savage Model 110

	short action	long action
Mainspring		
compression: opening	.247	.298
closing	.083	.061
total	.330	.359

IGNITION

	short action	long action
Firing pin travel: at impact —	.265 in.	.296 in.
dry-fired —	.330 in.	.359 in.
Lock time (ms.)	2.5	2.7
Impact velocity (ft./sec.)	19.5	19.8
energy (in.-oz.)	104.0	117.9
impulse (oz.-sec.)	.89	.99
Striker/firing pin hole diameters —	.065 in./ .072 in.	

RECEIVER

Overall length: short action —	8.69 in. (8.84 in. with recoil bracket)
long action —	9.26 in. (9.41 in. with recoil bracket)
Length of loading/ejection port: short action —	3.28 in.
long action —	3.82 in.
Ring diameter —	1.350 in.
Barrel threads —	1-1/16 - 20 UN
Recoil-lug bearing area —	.50 sq. in.
Guard screws —	1/4 x 28
Scope-mounting screws —	6 x 48

BOLT

	Savage 110 (1958)	Savage 110C (1966)
Lug shear area (sq. in.)	.413	.419
Lug bearing area (sq. in.)	.146	.119
Bolt diameter (in.)	.693	.693
Lug diameter (in.)	.996	.995
Bolt-face counterbore depth (in.)	.134	.118

Savage Model 110

MAGAZINE

Length: short action — 2.92 in.
long action — 3.34 in.

Capacity: .243 Win. — 4
7mm Magnum — 3

WEIGHT

	short action (110)	short action (110C)	long action (110B)
Receiver group	18.5 oz.	18.4 oz.	18.8 oz.
Bolt group	13.2 oz.	13.1 oz.	13.9 oz.
Magazine/floorplate group	5.8 oz.	7.6 oz.	4.8 oz.
Total action weight	37.5 oz.	39.1 oz.	37.5 oz.

Ranger Arms

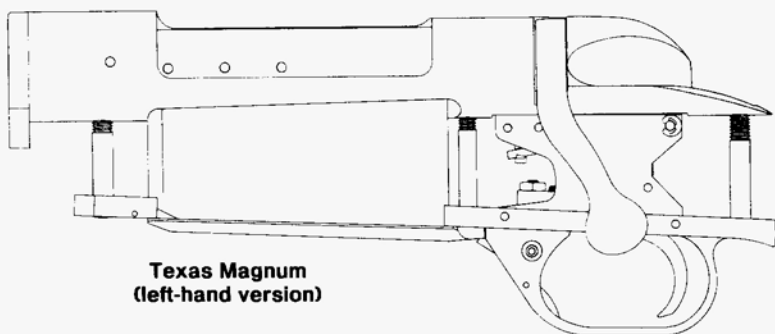


Ranger Arms officially opened for business in Gainesville, Texas, on January 7, 1967. Considering the modest assets of the new corporation, it was a lavish affair, attended by many Texas dignitaries and featuring the presentation of engraved and inlaid rifles to people like Governor John Connally and millionaire, big-game hunter Herb Klein. The origins of this enterprise traced back several years to two Dallas businessmen, Homer E. Koon, Jr., an insurance salesman, and John H. Brandt, a machinist and gunsmith.

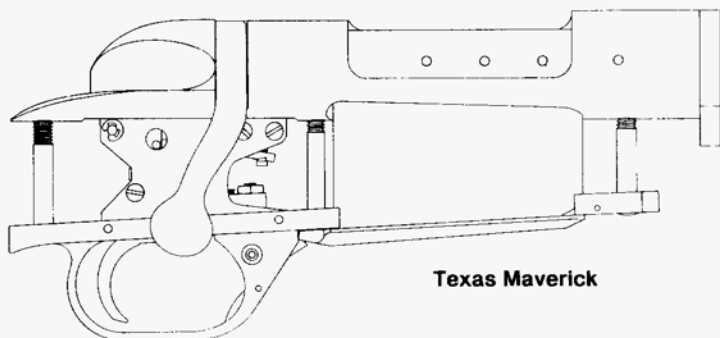
Brandt was resident gunsmith at Withers & Co. in Dallas in the early 1960s. Like so many gun buffs, he dreamed of making a new "improved" Mauser action and, in fact, had been toying with the idea since 1953 while attending the Colorado School of Trades. Through the years he had evolved some rather definite ideas, but had never gotten around to reducing them to a working prototype.

One idea concerned a smoother cocking system. In tuning up countless Mauser actions, he noticed the tendency of the cocking piece to rise during bolt lift. Polishing the cam surfaces could reduce but not eliminate this binding. Brandt envisioned a solution which encircled the firing pin axis with multiple cams to offset each other. He also had theories for a better locking system, patterned roughly after the massive symmetrical arrangements on bank vaults.

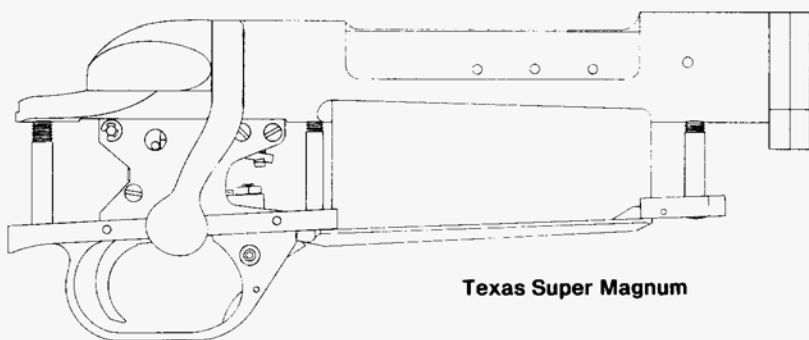
Without someone to promote these ideas, they probably would have remained where such things do for most of us, in the talking stage, or perhaps at best may have led to one or two custom rifles for personal use. This is where Homer Koon entered the picture. Koon's hobby was custom stock work, and around 1962 he started frequenting the Withers firm. There he befriended John Brandt, and eventually they got around to discussing Brandt's rifle design theories. By summer 1964 these discussions had led to some rather serious planning about manufacturing bolt actions. Brandt now had his own business in Dallas, "Brandt's Gunsmith Shop," but was heavily in debt. Koon suggested that a rifle-making corporation



**Texas Magnum
(left-hand version)**



Texas Maverick



Texas Super Magnum

would be a way for Brandt to get back on his feet financially and establish a solid income for the future. In the fall of 1964, Brandt agreed to finish his action and file for a patent; Koon was to come up with enough money to set up a corporation to manufacture it.

They originally envisioned an equal partnership, counting on finding a single buyer, such as Ruger or Smith & Wesson, to avoid marketing costs. On that basis, they rather optimistically hoped to get into production on the action for approximately \$20,000, an amount possible to raise between family and friends, without outside help.

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By June 1965 Brandt had finished up his prototype and applied for a patent on what they called the "Brandt 500" action. But he also became enmeshed in domestic problems, which Koon feared might tie up the action and patent application in a protracted legal battle. So Koon, who by now considered himself a gun designer in his own right, took the precaution of starting a parallel effort to build a rifle action of his own. Working with uncommon speed, he had a prototype and patent application completed by August 1965 for what would eventually become known as the "Texas Magnum."

Koon lost no time looking for customers, traveling East in September 1965 to show both the *Brandt* and *Koon* prototypes. Between this trip, and an energetic correspondence effort, he contacted nearly every major U.S. arms company not already marketing a high-power bolt action rifle, including Ruger, Smith & Wesson, Colt's, and Harrington & Richardson.

Koon also proceeded to set up "Brandt Arms," incorporated under Texas law in October 1965. Its three directors were John Brandt, Homer Koon and Robert Claxton, Koon's brother-in-law. Brandt's domestic troubles were now clearing up and Koon decided it would again be safe to work with the original Brandt 500 design. He and Brandt thus agreed to build a third and final action, incorporating the best features of the previous two. They also began setting up manufacturing facilities in Gainesville.

At this juncture, the partnership came apart at the seams. The hoped-for "single" buyer never materialized, so Koon and Brandt had to fall back on an alternative plan of marketing the action themselves to the gunsmith trade. It was now determined that at least \$100,000 would be needed. This meant outside investors, thus Koon considered the original 50-50 agreement no longer workable. He proposed instead a three-way deal, with Brandt and Koon each receiving one-third, the remainder being split between Claxton and the others who would be putting up the money. Logical as this might have been, Brandt would have none of it. He was also beginning to feel very uneasy about his long-term future in the corporation as Koon had drawn it up. Thus Koon and Claxton accepted Brandt's resignation from Brandt Arms in November 1965.

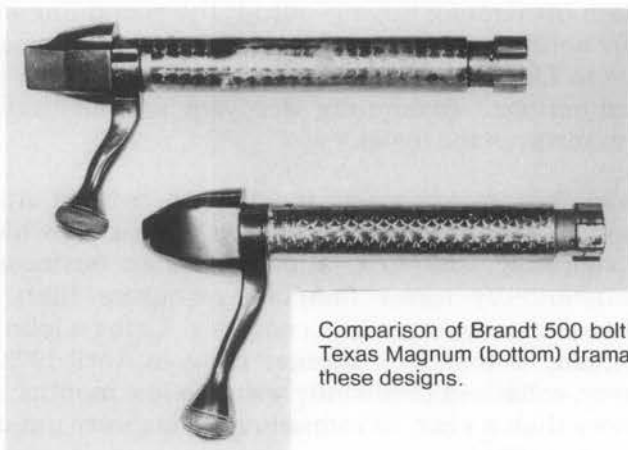
Brandt not only took his action and patent application with him, but wanted his name back also, as he intended to try to market the Brandt 500 himself. After some squabbling about who would pay for changing the state charter and for new stationery, Koon finally renamed his corporation "Ranger Arms" in July 1966.

Left on his own with his own action design (or so he thought), Koon

Ranger Arms

managed to raise enough money to finish the plant in Gainesville and began setting up for production in late 1966, about the same time the U.S. Patent Office was issuing John Brandt's patent (No. 3,274,724 of September 27, 1966).

Although Koon announced rather ambitious goals at the January 1967 opening of Ranger Arms (6,000 actions a year, of which 1,500 would be barreled and 600 finished into complete rifles), they in fact started out with neither the working capital nor manufacturing expertise necessary, managing to only build rifles on order, and to inventory very few actions. Then in June, as if Koon wasn't having enough problems trying to keep things going, John Brandt reappeared and sued Ranger Arms on the grounds that the Texas Magnum rifle infringed his Brandt 500 patent claims.



Comparison of Brandt 500 bolt (top) with that of Texas Magnum (bottom) dramatizes similarity of these designs.

While trying to defend against this lawsuit, things continued on the downslide at the factory. In addition to production problems, an unfortunate trigger arrangement made the action difficult to stock properly, and a lot of rifles began arriving in the mail for rebedding. Even though most of these had been stocked by outside gunsmiths, they ended up back in Gainesville because of the name stamped on the action. And by not charging for this service, Ranger easily wiped out the small profit margin they were counting on from the sale of each action.

By the summer of 1968 Koon was seriously looking for help. Of course, if you're seeking a benevolent millionaire sportsman to bail you out of this sort of thing, Texas is not the worst place in the world to be. Koon wanted to recapitalize Ranger Arms so he could inventory and market a line of complete rifles, not just bare actions.

Ranger Arms

With the actions retailing for only \$94.50, there just wasn't enough profit margin to support the operation.

In October 1968, Ranger Arms settled with John Brandt out of court, clearing the way for Koon's refinancing plans. That same month Dallas millionaire and sportsman Van Ellis bought controlling interest in Ranger. While Koon remained as general manager, Ellis brought in people from other companies he owned to actually run things, an arrangement which Koon hadn't anticipated, and which grew increasingly difficult for him as time passed. Finally, in April 1970 Koon left to set up another gun company (Omega Arms, Chapter 13).

Even with new management and capital, Ranger failed to prosper, and by September 1971 was again heavily in debt. This time Ellis assumed complete ownership, buying out all the remaining shareholders, and fully settling the debts of the corporation. It was now very solvent, due to Ellis' assets, but they still couldn't turn a profit on the rifles and actions. Eventually word got around that Ellis might be ready to throw in the towel.

Several potential buyers appeared, including a tribe of Apache Indians with plans to haul the entire operation to their New Mexico reservation. Eventually, Jim Cox, another Dallas businessman (although of substantially lesser financial resources than Ellis) decided to try his hand at owning a gun company. Using a loan from the Bank of Virginia, he took over Ranger Arms in April 1973. The company, however, collapsed financially within a few months. After sitting idle for more than a year, its remaining assets were put up for auction in September 1974.

Tom Felderhoff, a local Texas businessman, had by then already acquired the Koon patent (No. 3,330,061 issued July 11, 1967), while Joe DuBiel, Ranger's last plant manager and then caretaker, came away from the bank auction with Ranger's inventory and machine tools. Instead of combining forces to revive production of the Texas Magnum rifle, they ended up going separate ways.

Felderhoff worked for a while with a couple of entrepreneurs in Schulenberg, Texas, setting up "Jaguar Arms Corporation" to manufacture facsimiles of the Texas Magnum and Texas Maverick under the names "Magnum Stalker" and "Macho Cat." Without the manufacturing specifications, and failing in an attempt to enlist Homer Koon's help in the project, they were reduced to finding sample rifles to copy. A few rifles were eventually made in this manner, and brochures printed, but the operation never got very far off the ground.

Ranger Arms

DuBiel for his part decided to manufacture an entirely new bolt action rifle. All the Ranger machinery was hauled to Sherman, Texas, where he set up DuBiel Arms Co., which at this writing is making and selling rather high priced five-lugged rifles.

In all, during its eight years of existence, Ranger Arms sold somewhere between three and four thousand actions and rifles, obviously well short of their original goals. At the peak of activity under Ellis, they were employing just under forty people, half of them doing stock work.

The action was first available in the Texas Magnum version, intended for full-length and magnum cartridges, and available in either right or left-hand models at the same price. About a year later, a 5/8-inch shorter action designed for .308-length cartridges was added. Originally called the "Texas Mustang," it was renamed the "Texas Maverick" to avoid conflict with the car of the same name (Ford's "Maverick" was not yet out). This shorter version came in a southpaw model also.

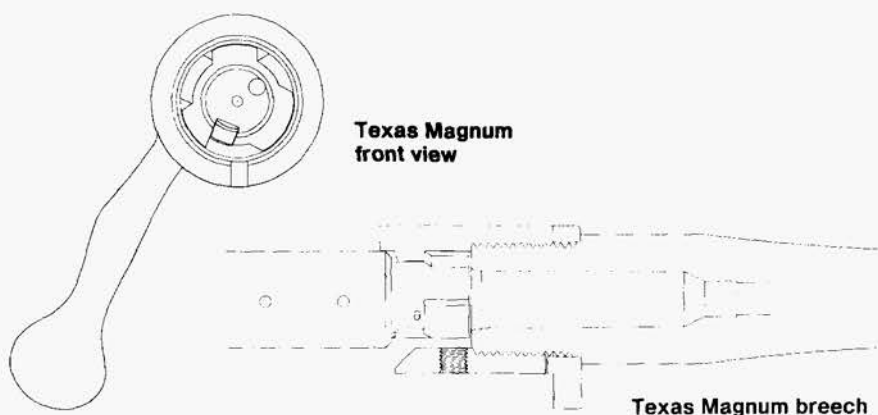
Much later, in 1972, the "Super Magnum" was added. About 3/16 inch longer than the Texas Magnum, it could handle the .375 H&H and .340 Weatherby without alteration to the receiver. In the text which follows, the term Texas Magnum is used generically to describe all three action lengths produced by Ranger Arms.



Left-hand "Super Magnum." Besides a longer receiver, double recoil brackets gave added rigidity in the stock.

Although no longer made, this Texas rifle left a distinct imprint on bolt action development. Three massive front lugs locked an oversized barrel-like bolt into a barstock receiver, in turn held in the stock by a clamped-on recoil lug and three sturdy guard screws. The symmetry of the design favored both right and left-hand versions. Orientation of the locking lugs was altered midway in the life of the

Ranger Arms



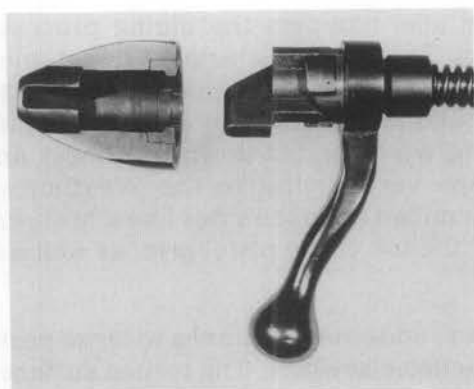
rifle, certainly not an everyday occurrence in arms manufacturing. A threaded bolt handle captured a dual-guided firing pin assembly, driven inside the bolt by probably the strongest mainspring ever put in a shoulder arm. Three evenly-spaced rear cams symmetrically retracted the firing pin, which was then controlled by a single-stage trigger fastened down on the base of the trigger guard, an arrangement previously common only to things like solid-frame shotguns.

The barrel is faced off square, then fitted to within approximately .020 inch of a counterbored bolt head to form the breech. Two gas ports vent the surrounding receiver ring, which is blocked at the rear by the oversize bolt body. A large shell type sleeve on the other end of the bolt blocks the receiver at the bridge, while three Weatherby-like ports drilled into the bolt body release any pressure entering through the firing pin hole.

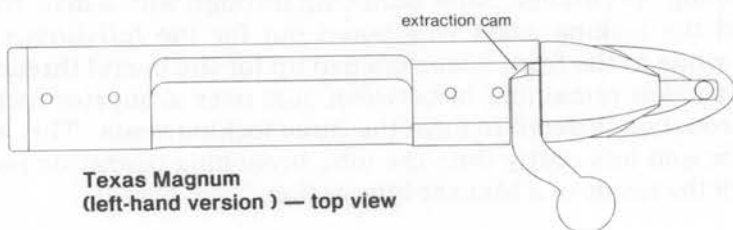
The bolt sleeve attaches by relatively shallow threads cut into its inner shell. Tolerances on these threads sometimes left this sleeve vulnerable to being dislodged by internal pressure, or even a rearward-driven firing pin. Interestingly, John Brandt objected to the idea of a shell-like bolt sleeve for precisely that reason back in 1965 when he was still working with Koon. Seven years later a prototype was built at Ranger which substituted relatively massive lugs for the threads, although by then it was a little late to start making basic changes to the production rifles.

The receivers were machined from AISI-4340 steel barstock, a nickel-chrome-moly alloy common to the aircraft industry. Similar to the AISI-4140 chrome-moly more often used in ordnance, it contains just enough nickel to yield a slightly tougher alloy in the

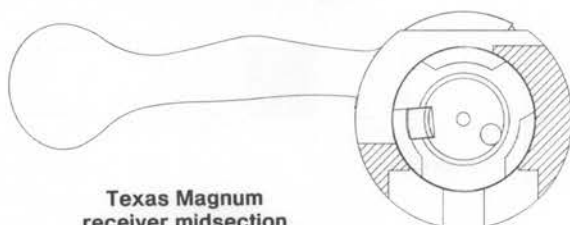
Ranger Arms



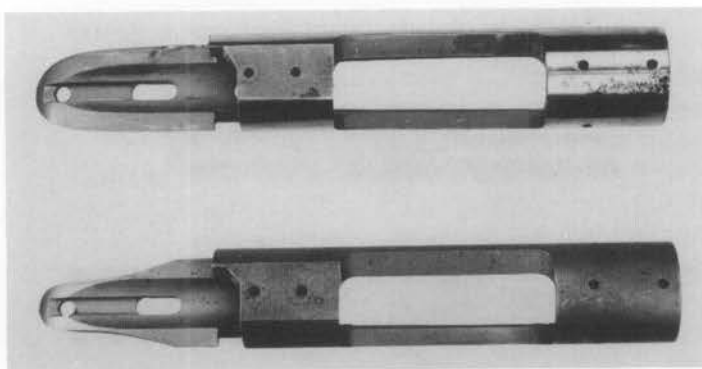
In prototype Texas Magnum (left), lugs replaced shallow threads used to retain bolt sleeve in production version (right).



**Texas Magnum
(left-hand version) — top view**



**Texas Magnum
receiver midsection**

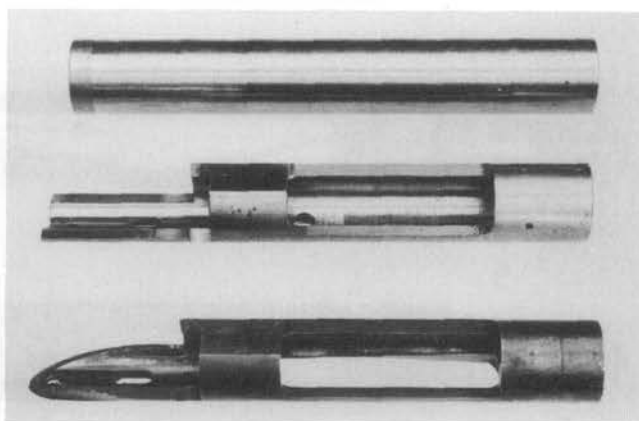
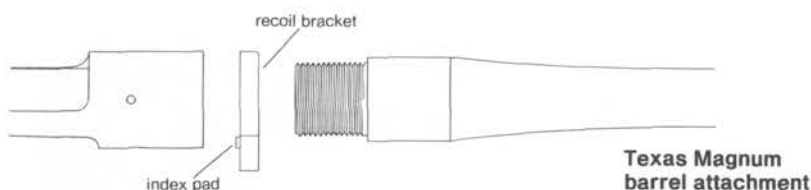


Original tang contour (top) was replaced with narrower version around 1971 (bottom).

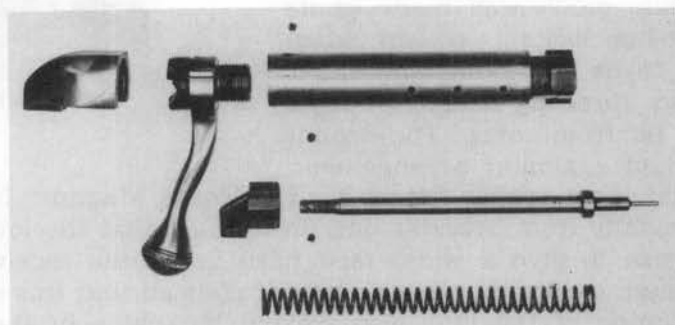
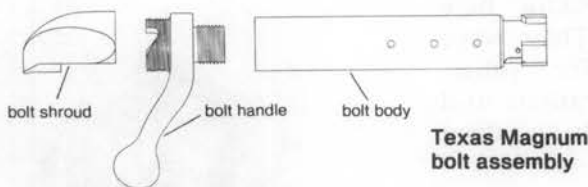
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heat treated state. This nickel also hampers the bluing process, however, so any net advantage in a sporting arm is debatable. Simply formed, these cylindrical receivers were turned to a basic 1.3-inch diameter, with the bridge then milled down an additional 1/10 inch for streamlining. The tang was blended down to almost an edge, leaving an elliptical shape very similar to the Weatherby Mark V. After about 1971, it was milled in on the sides like a Mauser tang, to improve the lines along the top of the pistol grip, as well as allow somewhat easier inletting.

The receiver is unusually "clean" underneath, thanks in large part to the fact that the trigger is attached elsewhere. The turned surface is interrupted only by the magazine opening, three holes drilled and tapped for the guard screws, and some slots for the sear and bolt stop. The interior was also formed by a relatively easy sequence of machining operations. After punching through with a drill, the area behind the locking seats was bored out for the *full-diameter* bolt body, while at the front it was opened up for the barrel threads. The small section remaining in between, just over a quarter inch long, was broached through to form the three locking seats. This was far quicker and less costly than the long broaching operation required to form the inside of a Mauser-type action.



Cylindrical Texas Magnum receiver started out as a solid piece of steel barstock.



Firing pin, mainspring, and cocking piece are assembled together with the bolt handle, then threaded into the bolt body and locked by two small setscrews. Hood-type bolt sleeve completes unit.

The investment-cast recoil bracket has a raised pad which aligns it during assembly with a slot milled into the front rim of the receiver ring. Once clamped in place by the barrel, this small plate presents a relatively small recoil surface for the stock, at least compared to many other modern actions intended for magnum cartridges.

The bolt is two pieces, with the handle threaded on at the rear. Gun designers had for years been welding, brazing, and soldering on bolt handles in order to avoid machining an intricate one-piece assembly. Koon introduced a new arrangement for center-fire bolt action rifles: the threaded-on bolt handle.

This threaded bolt handle created some unique problems of its own. Stripping a Texas Magnum bolt to get at the firing pin was a serious undertaking, certainly not a field operation in the same sense as a Mauser or Springfield rifle. And, on the other side of the coin, when the going got rough the two small setscrews which locked the bolt handle from turning weren't always up to the job. More than one Texas Magnum bolt began unthreading rather than extracting.

During manufacture the handles were threaded and locked into semifinished AISI-4320 alloy steel bolt bodies. After scribing witness marks and serial numbers, these assemblies were located in a

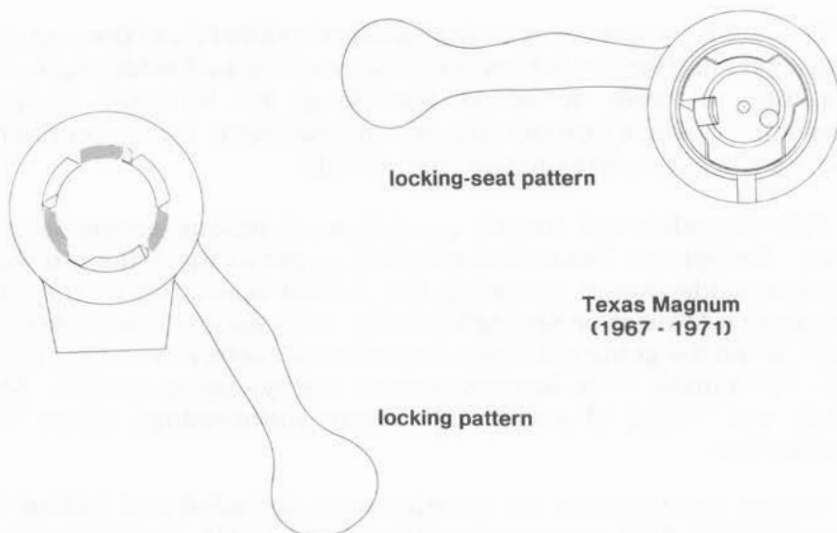
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fixture to mill the locking lugs and guide groove. They were then disassembled for subsequent machining operations and heat treatment, but always used thereafter as matched sets.

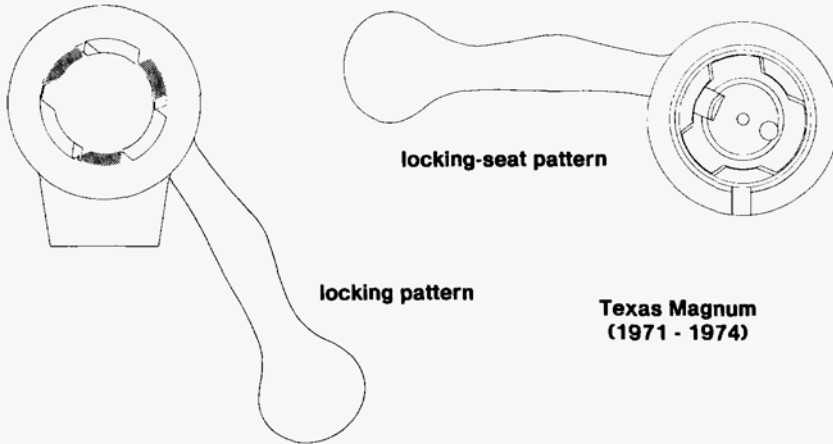
While much was made of its triple-lug locking system when the Texas Magnum was introduced, three-lug arrays were, in fact, far from novel. The Brandt 500 had a similar arrangement, as did other earlier firearms. The Texas Magnum lugs differed principally from Brandt's only in the fact that the lower lug was oversize to give a wider feed path inside the receiver ring for magnum cartridges. Koon's patent claimed that this slight reportioning of the lugs also yielded big gains in their effective strength, and interpretations of this theory found their way into some of the early magazine writeups on the new rifle. In practice, however, the wide feed path between the lower locking seats soon proved to be more of a burden than blessing. It afforded little lift for the cartridges and there was a tendency, particularly with the standard-diameter varieties, to jam into the back of the barrel. After muddling along for several years with the problem, the lugs were reoriented in 1971 to place one of the seats directly in front of the magazine as a feed ramp.



Brandt 500 bolt face

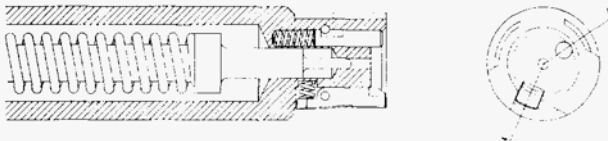


Ranger Arms



**Texas Magnum
(1971 - 1974)**

The arrangement of the extractor and ejector was rather conventional, except that the extractor was placed unusually close to the horizontal, giving a low trajectory to the ejected case. Many, in fact, failed to make it out over the receiver rail, falling back and jamming the action instead. When the lugs were shifted in 1971, the extractor was simply moved up to give a better trajectory to the empty case. A certain amount of extractor slippage was originally encountered also, but this was more of a production problem. The claws of these little investment-cast parts were being formed by hand filing, and many ended up very poorly shaped. In later-produced actions, they were finished in a special fixture to ensure better precision and uniformity.

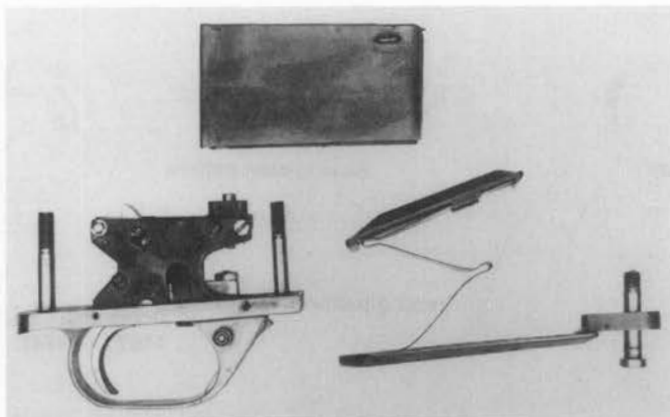


Texas Magnum bolt head details (1967 - 1971 version)

The magazine consists of a sheet metal box brazed at the rear into a solid unit. It is closed underneath by a floorplate, which is hinged at the front to a heavy steel plate and latched at the other end by the trigger guard.

Besides the usual drawbacks associated with the lack of a one-piece frame for the floorplate, the early rifles also had feed problems due to the ineffective feed ramp already mentioned, inadequate feed lips pressed into the top of the magazine box, and a free-floating cartridge follower. Compounding this was a sharp chamber entrance, which allowed very little margin of error in the alignment of incoming cartridges.

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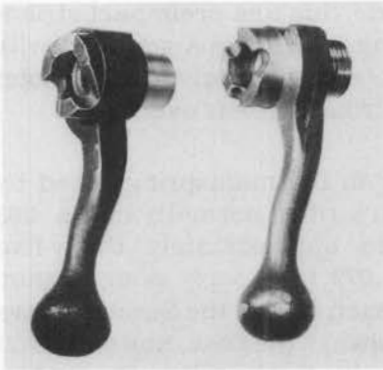
Floorplate was two-piece, like that of Winchester Model 70. Also, in early versions Ranger failed to attach the magazine spring to the floorplate. Biggest problem, however, resulted from pinning the trigger assembly down on the base of the trigger guard, rather than up underneath the receiver.

Attempts were made to correct all these things in later rifles. A two-degree upward slope in the receiver rails started the cartridges off on an angle, rather than allowing them to pop straight from the magazine, while the reoriented locking system placed a seat directly in the feed path. The follower spring was anchored in place. Finally, the chamber entrance was relieved, first with a shallow cone and later simply by radiusing its mouth.

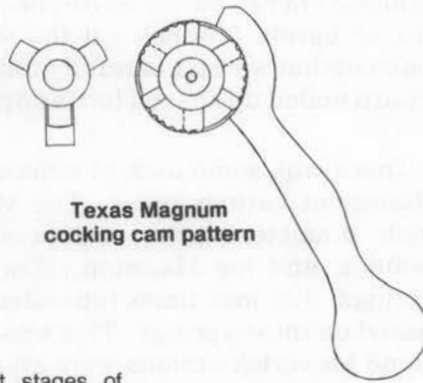
While Homer Koon placed great store in the strength of the Texas Magnum's locking lugs, this emphasis didn't carry through to the rifle's main operating cams. Others have done likewise in recent years, and weak camming seems almost symptomatic of modern design trends. In the heyday of the military manual rifle, when a lot of ordnance engineers were applying their skills to the bolt action, locking-lug strengths remained in perspective, and strong camming and smooth reliable functioning occupied central importance. In the Texas Magnum, you were lucky to find ten degrees of bolt rotation allotted for camming, and the resulting displacements and leverages simply couldn't do a very good job of chambering and extracting cartridges.

The rifle's cocking system was designed better. Multiple cams on the cocking piece, functionally equivalent to those in the Brandt 500, effectively eliminate binding of the firing pin. Their existence is fortunate, because not only does the Texas Magnum have a shortened bolt lift, but also perhaps the heaviest mainspring ever found necessary to ignite small arms ammunition. Most Texas Magnum rifles have at least a manageable bolt lift. Had the usual single cam been used it's doubtful many people could have even operated the rifle from the shoulder.

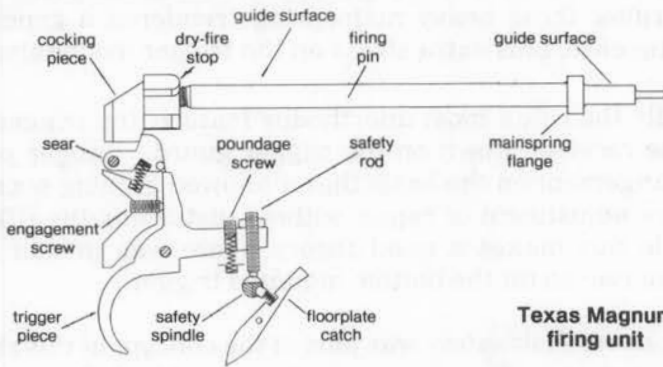
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Bolt handle, shown in two different stages of production, started out as an investment casting. So did the cocking piece, bolt sleeve, and much of the trigger and magazine assemblies.



Texas Magnum
cocking cam pattern



Texas Magnum
firing unit

The cocking piece, threaded onto the end of the firing pin and locked there by a small setscrew, establishes firing pin protrusion. Rather than making contact at its front rim like a Mauser, the actual face of the cams stop firing pin fall. This works in the Texas Magnum because there are three cams, combining for enough surface area to absorb repeated impact without damage. The shaft of the firing pin is guided at each end — inside the bolt handle, and up front in a specially reamed section of the bolt head. Like the triple cocking cams, this reduces internal binding, thus making for easier bolt operation.

In a quest for the ultimately fast lock time, Koon chose an arbitrarily short striker fall (advertised later as "half normal distance"). Combined with a Mauser mainspring, this also rendered an easy bolt operation in his prototype rifle. It didn't, however, ignite cartridges with much frequency. Koon was thus forced to substitute larger and larger mainsprings, finally ending up with an almost unbelievably massive .072-inch thick, forty pound brute. Even then,

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ignition energy bordered on the low side, due to a preimpact striker fall of barely 1/8 inch. If the stocking instructions supplied with each action weren't carefully followed, and the receiver and trigger guard ended up spaced too far apart, striker fall was even less.

There was some lack of consistency in the mainsprings used by Ranger at various times. The Maverick rifles normally had a .063 inch diameter spring compressed to approximately thirty-five pounds, and the Magnum rifles had .072 inch, forty pound mainsprings. The lock times tabulated for each rifle in the Summary are based on these springs. This was not always the case, however, and some Maverick actions were shipped with the heavier wire spring, and vice versa. When the Super Magnum came along, existing mainsprings were used, first with a spacer piece, then later by simply leaving a thicker front flange to maintain the same compression. In all Ranger rifles, these heavy mainsprings rendered a general lack of operating ease, plus extra stress on the trigger mechanism.

In undoubtedly the rifle's most unorthodox feature, the trigger is mounted off the receiver, down on the trigger guard. Ranger promoted this arrangement on the basis that it allowed gaining access to the trigger for adjustment or repair without disturbing the rifle's bedding. While this makes a good theory, there was in fact an entirely different reason for the bottom-mounted trigger.

A shotgun type crossbolt safety was part of the concept of this rifle from the very outset. This was perceived as ideal for quick operation, as well as for easing the transition from bird hunting to big-game hunting each season. And it was of course well suited for manufacturing a rifle in right and left-hand versions. It also, however, left little choice but to mount the trigger down with it. Unlike the shotguns from which the idea was copied, the Texas Magnum had a one-piece stock and two-piece action, rather than vice versa. With a sizable chunk of wood separating the trigger from the firing pin above it, this arrangement proved an endless source of problems. These problems didn't show up in the carefully assembled pilot rifles, but only after the actions were in wide circulation in the custom rifle-building trade.

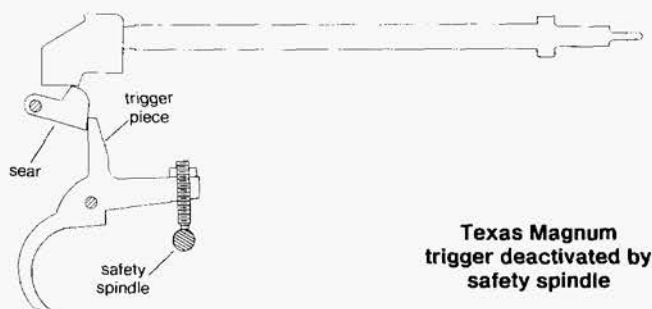
The "stand-up" or projection of the sear into the receiver to block the firing pin was a function in the Texas Magnum of the inletting of the trigger guard, and the tension of the guard screws. While this dimension is relatively large compared to the overlap of the internal parts of the trigger, it nonetheless seldom exceeds 1/10 inch, and slightly less in the Texas Magnum. If the rear guard screw worked loose, the trigger assembly could drop away from the firing pin,

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leaving the rifle at least temporarily out of commission. Lateral instability was also a potential problem. If the guard screws were overtightened so that the trigger canted to one side, the sear couldn't rise to block the firing pin. Routinely cinching up the guard screws prior to a hunt could inadvertently bind the trigger. Unless one then managed to free these screws out in the field, the rifle became so much dead weight.

Guard screw tension was thus critical not only to accuracy and point-of-impact, but simply to whether or not the rifle would even fire. While most owners may never have experienced such problems, just the fact that they were possible was unacceptable. Enough things can ruin a hunting trip without inventing more. Ranger eventually got around to developing an improved prototype rifle with a receiver-mounted Timney trigger and safety unit, but by then production of the Texas Magnum was falling off to the point where it was really too late for that type of change.

Internally, the sear is pivoted at the rear and supported underneath by the head of the trigger piece, which is in turn blocked by a notched safety spindle housed in the front web of the trigger guard. Adjusting screws are provided for the trigger spring and the initial position of the trigger piece. After setting sear engagement, a threaded rod in the front arm of the trigger piece can be used to calibrate the safety. It is turned in until just enough clearance remains for free movement of the safety spindle, thereby ensuring a maximum safety margin.



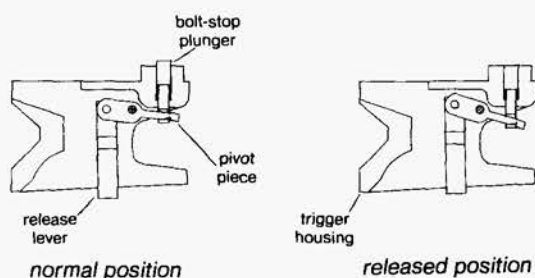
There is no bolt lock. Also, after firing, the trigger piece snaps back far enough to both entrap the sear downward and allow movement of the safety spindle. Thus, if the safety is engaged before cycling the bolt again, the firing pin doesn't cock. Instead, it will simply slide down the cam notches and onto the primer of the next cartridge.

When this rather peculiar phenomenon was discovered, manufacture was already underway. Rather than disrupting production by

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trying to redesign any of the parts, Ranger decided to promote it as a positive feature, in fact as a breakthrough in the manner of handling a hunting rifle afield. Instead of carrying the rifle cocked, with the safety engaged, one could carry it around with the firing pin tip pressing on a live primer. Supposedly this was safer and would allow a faster first shot.

Neither argument is overpowering. Accepted wisdom, returning back to the days of Paul Mauser, held strongly against the idea of resting firing pins on primers, which even then could be easily accomplished by simply depressing the trigger while carefully cycling the bolt. Admittedly, the rifles of those days had exposed cocking pieces, but the precedent was set. One need only look through back issues of the *American Rifleman* to find periodic warnings on the subject. Also, considering the size of the Texas Magnum mainspring, the idea that this was a fast way to get off a first shot was not really that persuasive either.



Texas Magnum bolt stop

A 3/16 inch diameter rod, located in the trigger assembly and spring loaded up to engage a groove milled along the underside of the bolt body, acts as a bolt guide and bolt stop. Pressing a release lever in the trigger bow pivots the rod down for bolt removal. Because there are no override bevels, this procedure must also be followed when reinserting the bolt. Quite small in comparison to the Texas Magnum bolt, breakage of this bolt stop plunger was another chronic problem for Ranger throughout the years the rifle was in production.

Summary

The Texas Magnum was an interesting, and in a sense influential, rifle design. It suffered, however, from a general lack of sound and practical engineering. The heavy mainspring and short bolt lift increased operating forces. The extraction and chambering cams

Ranger Arms

were not equal to those of quarter-turn Mauser actions, and the trigger/safety arrangement created far more problems than it solved. The following summarizes the action's strong and weak points:

Strong points:

1. Short lock time.
2. Multiple cocking cams.
3. Good trigger access.

Weak points:

1. Weak extraction and chambering.
2. Poor magazine feed.
3. Indirect-mounted trigger.
4. Trigger-block safety.
5. Threaded-on bolt handle.
6. Shallow bolt sleeve threads.
7. Lack of size and override bevel on bolt stop.
8. Lack of cocking indicator.

Ranger Arms Dimensions

OPERATING

Extraction: set-back — .09 in.
leverage — 5 to 1

Chambering: cam-forward — .07 in.
leverage — 6 to 1

Bolt rotation — 60°

Bolt travel: Texas Maverick — 3.64 in.
Texas Magnum — 4.32 in.
Super Magnum — 4.54 in.

Cock-on-opening: .184 in.
mainspring compression
proportioned as follows:

opening — .170 in.
closing — .014 in.

Ranger Arms

IGNITION

Firing pin travel: at impact — .124 in.
dry-fired — .184 in.

	Texas Maverick	Texas Magnum
Lock time (ms.)	1.9	2.0
Impact velocity (ft./sec.)	11.5	12.3
energy (in.-oz.)	60.0	72.8
impulse (oz.-sec.)	0.82	0.99

Striker/firing pin hole diameters — .079 in./ .082 in.

RECEIVER

Overall length: Texas Maverick — 8.35 in. (8.60 in. with recoil bracket)
Texas Magnum — 8.97 in. (9.22 in. with recoil bracket)
Super Magnum — 9.15 in. (9.65 in. with recoil brackets)

Length of loading/ejection port: Texas Maverick — 2.72 in.
Texas Magnum — 3.32 in.
Super Magnum — 3.57 in.

Ring diameter — 1.310 in.

Barrel threads — 1 - 14

Recoil-bracket bearing area — .30 sq. in.

Guard screws: front and rear — 1/4 x 28
middle — 12 x 28

Scope-mounting screws — 6x48

BOLT

	1st style	2nd style
Lug shear area	.489 sq. in.	.505 sq. in.
Lug bearing area	.068 sq. in.	.066 sq. in.

Bolt diameter — .860 in.

Lug undercut diameter — .678 in.

Lug diameter — .860 in.

Bolt-face counterbore depth — .120 in.

Ranger Arms

MAGAZINE

Length: Texas Maverick — 2.92 in.

Texas Magnum — 3.53 in.

Super Magnum — 3.78 in.

Capacity: .30-06 — 4

7mm Rem. Magnum — 3

WEIGHT

	Texas Maverick	Texas Magnum
Receiver group (w/recoil bracket)	14.4 oz.	15.5 oz.
Bolt group	16.2 oz.	17.0 oz.
Magazine/floorplate group (w/trigger assembly)	13.0 oz.	13.2 oz.
Total action weight	43.6 oz.	45.7 oz.

SHIKAR

Voere Shikar

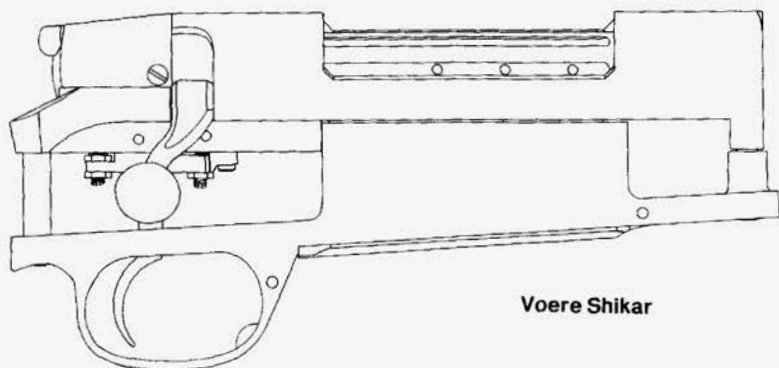
The Shikar, as it was known in this country, was the first attempt by the Voere Co. to design and build a bolt action high power rifle. A relatively new firearms company, at least by European standards, Voere (officially "Voere Schwarzwälder Jagd-und Sportwaffen-fabrik, Voetter & Co.") was set up in Vohrenback, West Germany, shortly after World War II.

Started in 1965, the rifle project was assigned to Josef Hartl, a young engineer with a relatively limited background in firearms design. Experienced or not, work at Voere proceeded quite rapidly. Pilot rifles were ready less than two years later, and were first shown in this country at the NSGA Show in Chicago in early 1967. Boasting a lot of "California" flavor, the new rifles immediately struck the fancy of many gun reviewers, being frequently compared to the Weatherby Mark V rifle.

The rifle was made in three variations, the Model 2130A (American) chambered in .243 and .270 Winchester, the 2130M (Magnum) in .300 Winchester Magnum and .308 Norma Magnum, and the 2130E (Europe) in various metric cartridges. The first two versions were imported into this country by "L.A. Distributors," who also arranged to have the receivers inscribed with the "Shikar" designation.

Within a couple of years Voere had grown dissatisfied with the marketing efforts of L.A. Distributors. Arrangements were made for Bob Kleinguenther, a native of Germany, and a Weatherby employee for many years, to take over the rifle line. "Kleinguenther's Distinctive Firearms" was incorporated in Sequin, Texas, in March 1970 to market Voere rifles. This main operation was supplemented also by several other lines of foreign arms. The remaining stocks of those Shikar rifles which were already in this country, and inscribed on the barrel with the L.A. Distributors name, were eventually disposed of by a third party, "Marketing Unlimited."

Kleinguenther was never overly impressed with the Shikar rifle. From the outset he recognized that some very fundamental design



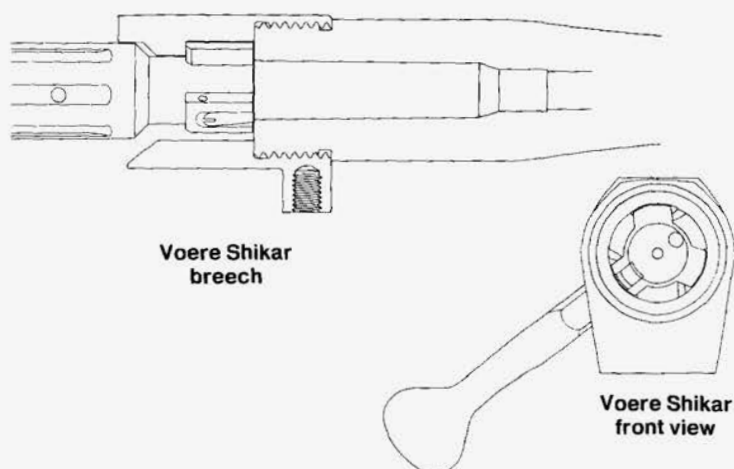
Voere Shikar

changes were needed. After several trips back to Germany, he succeeded in converting Voere to this same viewpoint. A project to completely revamp the rifle's design eventually culminated in 1973 with the Voere M2145, known in this country as the K-14 Instafire (Chapter 14). Meanwhile, however, Voere continued making the old design for another year or two, keeping Kleinguenther very busy trying to market them. In an attempt to boost these sales, he came up with a couple of new designations for the original rifle, first the Kleinguenther M-V-2130, then the K-14.

To dispose of Voere's final shipments, Kleinguenther marked the rifles down below even the point that L.A. Distributors had been discounting them. Also, during this time, a relatively small number of "Apollo" rifles were built in Southern California, using the Shikar action and chambered in a unique variety of high-velocity cartridges. In all, roughly 25,000 to 30,000 rifles (all of which for convenience will be referred to in this chapter as "Shikars") were built and sold during their five or six-year lifespan.

The Shikar action was a cultural crossbreed. It had "California" styling and features such as a flush multiple-lug bolt, laced with gas ports along its side and capped on the end with a heavy shroud-type bolt sleeve. But it also had a Mauser barrel and a large dose of "German" precision, particularly in the fit of its inner working parts. The receiver was somewhat geometric in shape, with flat and even surfaces on top, an octagonally styled floorplate underneath, and two fully bushed guard screws in between. The walls of the bolt head and receiver ring were perhaps as thin as any found in a high power rifle, while Voere's use of special-diameter bolts was certainly a unique solution to the problem of handling belted magnum cartridges. The firing pin was blocked by a compound-movement sear, supported underneath by a trigger piece which also controlled the bolt stop. A long pivoting lever protruding out the back of the bolt sleeve acted as the two-position safety.

Voere Shikar



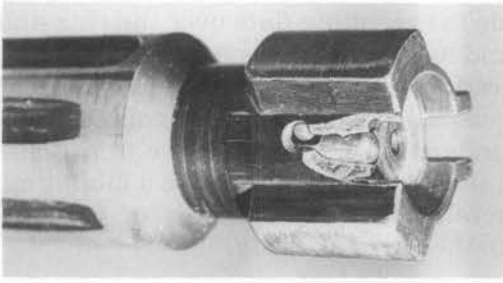
The Shikar's breech is formed by a flat-nosed bolt head in combination with a square-ended barrel. A collar inside the receiver ring superficially resembles that in the Mauser M98, but encircles the locking lugs rather than a protruding bolt nose, thus no useful gas barrier is formed. The collar was actually a simple consequence of the fact that the barrel threads are considerably larger in diameter than the bolt head.

The barrel tenon has the same threads as a Mauser 98 and will, in fact, turn fully into a Mauser receiver, roughly fitting up against the bolt. Headspace will be grossly incorrect, however, as the Shikar bolt head has a much deeper counterbore recess than the Model 98.

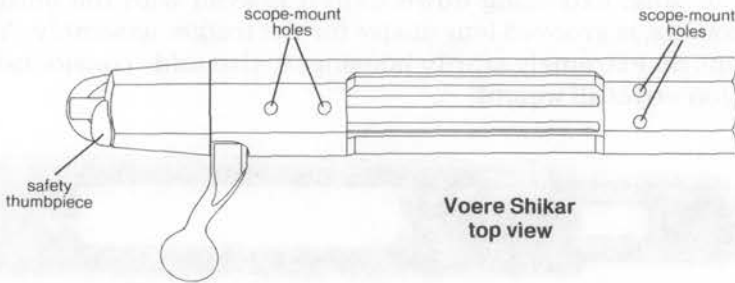
Voere fitted the barrel for minimum cartridge-head protrusion. In our sample rifle there was only a .005 inch gap between the bolt and barrel. The barrel seats directly inside the receiver, rather than out at the front rim of the receiver ring. This system, used in the classic Mauser rifle, not only controls cartridge-head protrusion with more precision, but it forms a permanent reference point not subject to the skill of the gunsmith in any subsequent rebarreling operation.

Besides fitting so close to the bolt, the barrel's chamber mouth has very little chamfer. These factors all combine to give an *effective* cartridge-head protrusion not much in excess of the .125-inch depth of the bolt-face counterbore itself. Encirclement of what cartridge head circumference does protrude from the barrel, however, is a rather mixed bag. While the bolt head counterbore is interrupted only by a single, narrow extractor slot, the walls themselves don't amount to much, being in fact so thin that blown-out Shikar bolt heads are not that uncommon.

Voere Shikar



The Shikar's thin bolt-rim walls were susceptible to being carried away by escaping gas.



The receiver ring tends to entrap and control any gas escape. Not only does it lack gas ports in its walls, it is blocked off at the rear by the enlarged shoulder behind the bolt head, leaving only the magazine feed ramp for gas release. Any flow which does occur along the bolt exterior is opposed at the point where the collar-like base of the bolt handle recesses into the bridge. Behind that is an equally close fit of the bolt sleeve against the rear of the receiver bridge.

Gas entering the bolt interior is blocked by the head of the firing pin, while further back a string of three ports open into the receiver's loading port. On the end, the bolt sleeve mechanically entraps rearward firing pin movement, plus partially shrouding off gas. Its rear wall can't fully control gas escape because of two penetrations, one which allows the rear tip of the firing pin to act as a cocking indicator, and the other for the vertical movement of the safety lever.

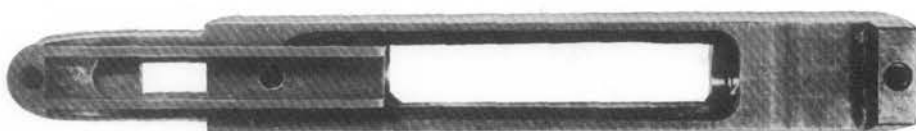
The receiver, machined from oversize steel barstock, ends up with a rather geometrical exterior. It is perfectly flat on top, while the sides are profile-milled to an elliptical contour, yielding both a pleasingly streamlined appearance and a lot of metal at the receiver's midsection for rigidity.

The bridge is milled down on top only to the height of the receiver ring, thereby avoiding the very shallow scope-base threads

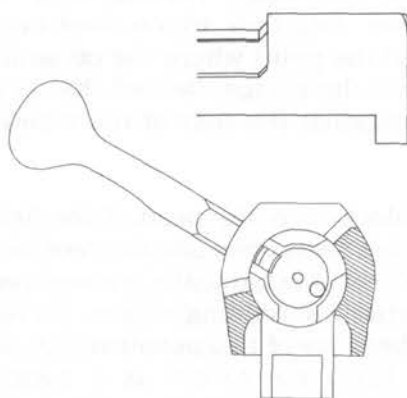
Voere Shikar

sometimes found here in receivers which have been bored out inside for "full-diameter" bolts. While the resulting flats over the ring and bridge are of identical width and height, their scope base holes don't match. The forward holes straddle the upper locking seat, rather than lying on center. This unusual pattern, which of course eliminated the possibility of one standard base, did not derive from some esoteric theory for increasing the stability of the scope's mounting, but simply reflects a strong reluctance on the part of German gunmakers to drill through into the barrel threads.

The tang, extending down until it is even with the bottom of the recoil lug, is grooved lengthwise for the trigger assembly. While this forms an extremely sturdy housing, it also adds considerably to the action's overall weight.



The Shikar receiver demanded a lot of milling. One of these operations involved cutting out the large trigger cavity underneath the rear tang and bridge.



Voere Shikar
barrel attachment

Voere Shikar
receiver mid-section

Because of the full-diameter bolt, the receiver interior is a perfect cylinder, save for the locking seats broached in the receiver ring. In contrast to its thick midsection, the forward receiver walls which surround the barrel are extremely thin. While the barrel threads are the same diameter as those in the Mauser 98, the Shikar's receiver ring comes nowhere near matching the exterior dimensions of the Mauser. Thus, wall thickness on the sides is less than .075 inch, with barely .050 inch on top. As with the bolt, some thorny dimensional contradictions arose in Voere's quest for a "trim" bolt action. According to Kleinguenther, however, the thin receiver-ring

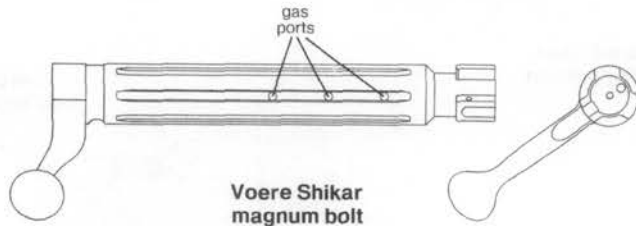
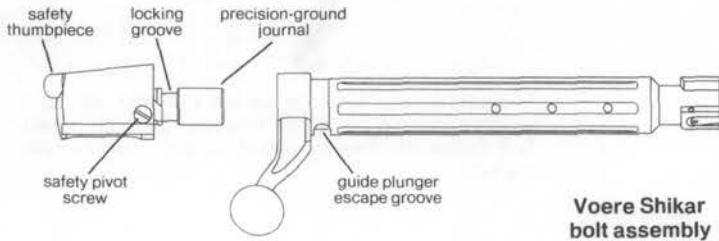
Voere Shikar

walls never led to the kind of failures which he has seen with the Shikar bolt heads.

The Shikar's bolt was to a large extent inspired by that in the Weatherby Mark V rifle. Incorporating similar overall styling, it has non-protruding multiple lugs, full-length fluting, and triple gas ports along the side. It is smaller in diameter, however. In an effort to combine relatively modest body and locking lug diameters (.78 inch), with locking surfaces which have adequate depth and width to avoid the need for more than a single array of lugs, the head of the Shikar bolt was undercut to a .550 inch diameter behind and between the lugs. With a diameter in the bolt-face counterbore of .480 inch, the bolt rim walls end up only .035 inch thick ($(.550-.480) \div 2$).

When the time came to introduce magnum chamberings, it obviously became necessary to tool up for a larger bolt. Its diameters were simply increased by the difference between a magnum and a standard cartridge head, thus retaining the same marginally thick .035 inch rim by use of a .61 inch bolt head. This compares with at least a .70 inch diameter bolt head in most other high-power bolt actions, the Weatherby Mark V included.

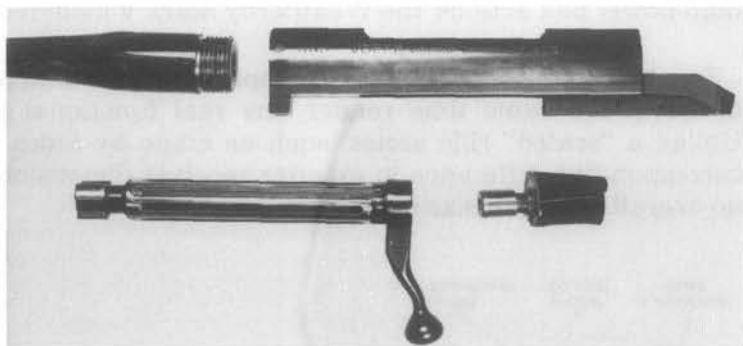
Two bolt diameters obviously complicated production. And they didn't at the same time render any real functional advantages. Unlike a "scaled" rifle series, such as made by Sako, there is no corresponding difference in exterior receiver dimensions, and thus no overall weight or size benefits.



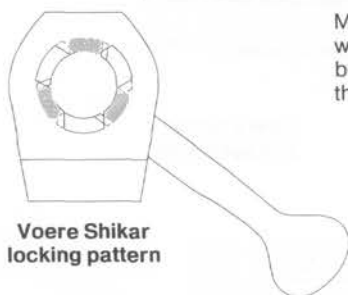
Voere Shikar

The investment-cast bolt handle has a massive collar formed at its base which presses onto the rear of the bolt body. The two parts are then pinned together permanently with a thick dowel, which continues through a short distance into the bolt bore to serve as an anchor point for the bolt sleeve. Upon lockup, the front rim of this circumferential bolt handle collar seats in a special counterbore cut into the rear of the receiver bridge to form a block against escaping gas. The rear rim of this same permanent collar enshrouds the back of the bolt body to help keep dirt off the cocking cams. Later magnum bolts lacked a collar, and the bolt handle was instead simply welded to the side of the bolt body.

Behind the collar, a shroud-type bolt sleeve blends nicely with the exterior lines of the receiver. It is held in place by a close-fitting ground journal, slotted and grooved to accept the inward-projecting bolt-handle dowel upon assembly. This arrangement produces no back and forth shift of the bolt sleeve as the bolt rotates, such as occurs with threaded assemblies. Dismantling is also somewhat simplified, requiring but a fractional rotation between the two parts.

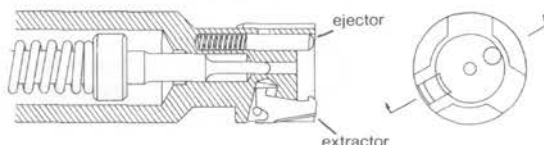


Massive-looking receiver belies the thin sections which surround the barrel threads. Smooth-nosed bolt sleeve attaches by way of a sturdy dowel inside the bolt.



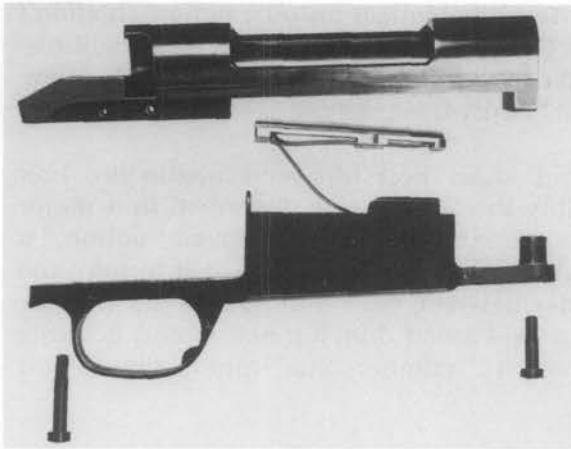
Voere Shikar
locking pattern

Voere Shikar
bolt head details



The bolt head is milled away to leave three "non-protruding" locking lugs. As noted previously, each was made large and deep enough so that they combine to provide adequate strength without multiple rows. Their layout, in fact, renders just about as much contact surface with the corresponding seats in the receiver ring as is practical in a single three-lug array. The locking lugs, as well as their receiver seats, are of uniform size, and cut on a symmetrical one hundred twenty-degree pattern. A bolt turndown of sixty-eight degrees allows enough extra rotation to overlap the cam bevels, and thus center the actual contacting faces for optimum bearing efficiency. Both the bolt handle, and a sturdy vertical guide bar which turns into a groove at the rear of the bolt during lockup, serve as potential safety lugs.

The extractor is a small steel hook pinned inside one of the locking lugs, and urged into engagement by a tiny entrapped coil spring. While its narrow claw grips only one-tenth of the cartridge-rim circumference, an angled foot at the base of the extractor at least helps it draw inward and prevent slipping as it pulls the fired case away from the chamber walls. A spring-loaded pin recessed into the opposite side of the bolt face cooperates with the extractor to eject cases on about a thirty-degree trajectory out the loading port of the receiver.



Lightweight aluminum trigger guard is cast as one piece. Not shown is rear guard screw bushing fitted in stock to limit compression of wood under tang.

The trigger guard and magazine housing is formed as a one-piece aluminum casting. At four ounces, it weighs only roughly half as much as the similarly sized and shaped steel unit in the Mauser 98. The octagonal outline of the floorplate blends very nicely with the overall geometric pattern of the receiver. Hinged at the front, the floorplate is secured at the other end by a latch pivoted in the front web of the trigger bow.

Voere Shikar

An integral front guard screw bushing resembles that on the Mauser 98, while a thin steel tube surrounds the rear guard screw to limit stock compression on assembly. Tabs cast into the top of the magazine box position and lock it in place under the receiver when the guard screws are drawn up. The interior walls of this magazine box are perfectly straight, leaving the control of each cartridge entirely to guide lips milled into the lower cavity of the receiver.

The cartridge follower is a solid-machined steel part, smooth and carefully blended on top, while hollowed out underneath to eliminate extraneous weight and to form retaining lugs for a W-shaped ribbon spring.

More than any other single factor, difficult bolt operation proved the undoing of the Shikar rifle. The rifle had the slick lines and short bolt lift of the Weatherby school of design, but also shared a tendency for weak camming and high bolt-handle forces. A heavy mainspring, short-lift bolt, and inefficient cams, combined with a lot of internal binding to render perhaps the stiffest-working bolt ever found in a factory rifle.

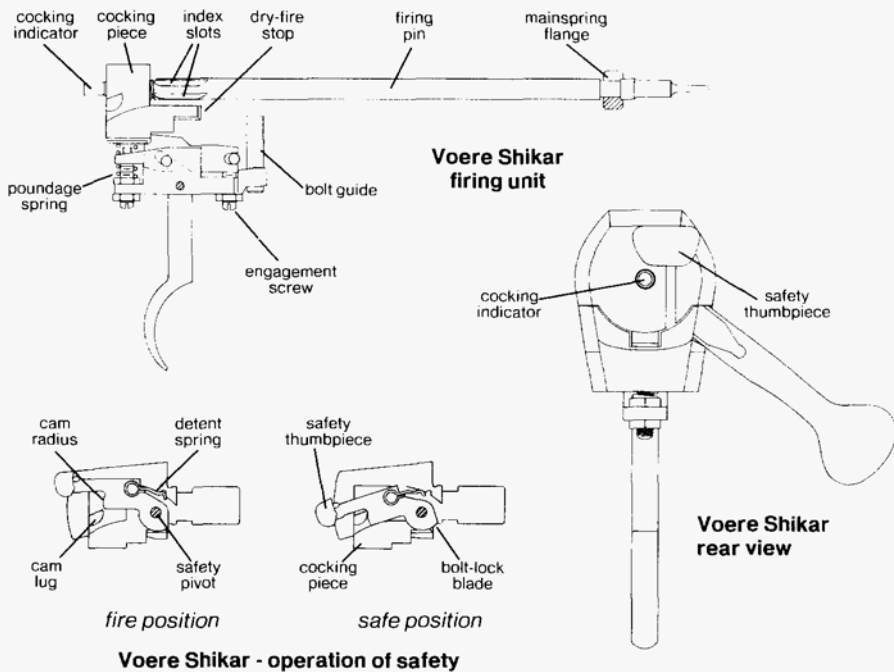
Most multiple-lug actions operate a little on the stiff side. Since work equals force times distance, short bolt movement necessarily translates into higher forces, but this needs perspective. Cocking the mainspring in a good two-lug Mauser-pattern action shouldn't involve more than about a five-pound bolt lift. In a typical multiple-lug action, this may increase to perhaps ten pounds or slightly more. In the Shikar it runs almost twenty-five pounds!

Despite much talk about short bolt lifts and piston-like bolt movements, and remarkably the Shikar was described in a major magazine evaluation as possessing a "slick and speedy action," a short bolt lift is of little practical value if you're forced to take the rifle down from the shoulder between each shot just to pry it open. Thus the easy bolt lift of a well-tuned dual-lug action can actually yield much faster operation, its "cumbersome" ninety-degree bolt rotation notwithstanding.

The Shikar bolt isn't particularly easy to close either. Without sufficient cam geometry to engage the extractor, it has to be muscled directly over the rim of a chambered cartridge before the cams even come into play.

The Shikar firing pin is formed in two pieces. A wide but shallow groove near the front of the firing pin shaft accepts a heavy slip-on mainspring flange. At the other end, a block-like cocking piece

Voere Shikar



threads into place. Four index slots cut just forward of the cocking piece cooperate with the tip of the safety pivot screw to prevent turning of the firing pin once it is assembled into the bolt. Since the cocking piece threads have a one-millimeter pitch, protrusion of the striker tip at the other end can be adjusted in steps of one-quarter millimeter (.010-inch).

The rear tip of the firing pin extends a short distance beyond the cocking piece to align with a small opening in the back wall of the bolt sleeve. Painted red, this tip serves as a cocking indicator by lying just flush with the bolt sleeve when the action is ready to fire.

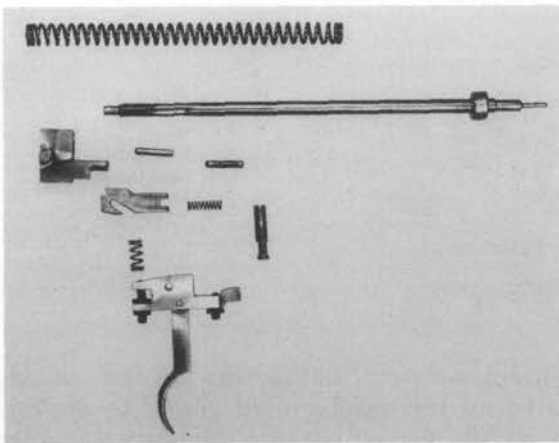
A lever installed lengthwise in the bolt sleeve provides the Shikar with a two-position safety. Pivoted at its forward end, it extends back through a slot in the rear wall of the bolt sleeve where it can be operated by way of a moulded-on black plastic thumbpiece. While not particularly difficult to operate, it does lack some of the accessibility and familiarity of the more traditional thumbpiece locations closer to the bolt handle.

The safety lever is blanked from steel plate. Near the middle of this lever is a precision cam radius which is machined, then

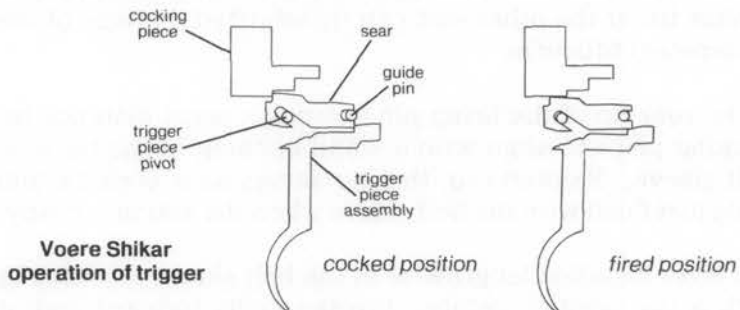
Voere Shikar

hardened to resist wear. Pivoting on a large pin threaded into the side of the bolt sleeve, the safety is detented in each position by a small entrapped wire spring. With its thumbpiece raised, the cam radius on the lever clears a corresponding lug projecting from the right side of the cocking piece, thus allowing the rifle to fire. Simultaneously, the front edge of the lever is drawn in flush with the bolt sleeve flange to unlock the bolt.

Pressed down to the *safe* position, the lever engages the cocking-piece lug, forcing the entire firing pin assembly back about .005 inch. The front edge of this lever also revolves forward into a locking slot milled in the rear rim of the bolt.



Firing unit in Shikar features unusual sear movement, and trigger piece with only limited adjustments.



The Shikar trigger is a somewhat unorthodox variation of an override or blocked-sear design. The parts are located between two heavy flanges under the rear tang, rather than inside a trigger housing attached separately to the receiver. Movement of the sear which serves to block the firing pin is controlled by two guide pins. It neither purely slides nor rotates downward in releasing the

cocking piece, instead undergoing a combination of the two motions. Pressure from the firing pin presses the sear forward, while an angled slot engaging the rear guide pin causes it to simultaneously dip at the back. The result is a compound or "slouching" movement as it clears during firing.

The trigger piece itself is a fabrication of two parts; a finger piece and an upper head which makes the contact with the sear. The degree to which it engages the sear is controlled by a small vertical screw in the front flange of the trigger piece head. A second screw on the rear flange limits overtravel. Because trigger pull actuates the bolt stop, and overtravel is by nature so great (almost .15 inch), this adjustment is of little practical benefit. Also, an adjustment for the poundage spring was overlooked.

A round steel rod projecting vertically from the front flange of the trigger piece head both guides the movement of the bolt and limits its rearward travel. The engagement between this rod and a lengthwise groove cut along the underside of the bolt gives close angular control, even when the bolt is drawn fully to the rear. Pressing back hard against the trigger lowers the rod flush with the receiver bore to permit bolt removal or insertion.

Summary

The Shikar might be viewed as an economy European version of the Weatherby Mark V. But it was perhaps even less than that. It had more design shortcomings than should exist in a factory arm, even a first attempt from an arms company.

The very thin sections in some critical strength areas on the rifle suggest a certain incoherence in Voere's engineering approach. So did the need to go to a separate bolt size for magnum chamberings. But binding of the internal parts, and the resulting difficulty experienced in trying to cock the rifle, was by far its worst fault.

The following summarizes the strong and weak points of the Shikar action:

Strong points:

1. Strong locking lugs.
2. Good gas handling.
3. Rigid receiver.
4. Direct-acting safety.

Voere Shikar

Weak points:

1. Lack of poundage and over travel control for trigger.
2. Weak camming system.
3. Excessive operating forces.
4. Thin bolt counterbore walls.
5. Noisy safety operation.

Voere Shikar Dimensions

OPERATING

Extraction: set-back — .08 in.
leverage — 6.5 to 1

Chambering: cam-forward — .05 in.
leverage — 11.5 to 1

Bolt rotation — 68°

Bolt travel — 4.46 in.

Cock-on-opening: .242 in.

Mainspring compression proportioned as follows:

opening — .250 in.
closing — -.008 in.

IGNITION

Firing pin travel: at impact — .186 in.
dry-fired — .242 in.

Lock time — 2.6 ms.

Impact velocity — 13.6 ft./sec.
energy — 74.1 in.-oz.
impulse — .91 oz.-sec.

Striker/firing pin hole diameters — .079 in./ .081 in.

RECEIVER

Overall length — 8.74 in.

Length of loading/ejection port — 3.35 in.

Ring diameter — 1.247 in.

Barrel threads — 1.1 - 12

Recoil-lug bearing area — .37 sq. in.

Guard screws (metric) — M6x1

Scope-mounting screws (metric) — 3.75x.7

BOLT

Lug shear area — .469 sq. in.

Lug bearing area — .085 sq. in.

Bolt diameter — .784 in. (.842 in. Magnum)

Lug undercut diameter — .550 in. (.607 Magnum)

Lug diameter — .784 in. (.842 Magnum)

Bolt-face counterbore depth — .125 in.

MAGAZINE

Length — 3.37 in.

Capacity: .30-06 Springfield — 5
7mm Remington Magnum — 3

WEIGHT

Receiver group 20.3 oz.

Bolt group 14.8 oz.

Magazine/floorplate group 6.4 oz.

Total action weight 41.5 oz.

Schultz & Larsen Denmark

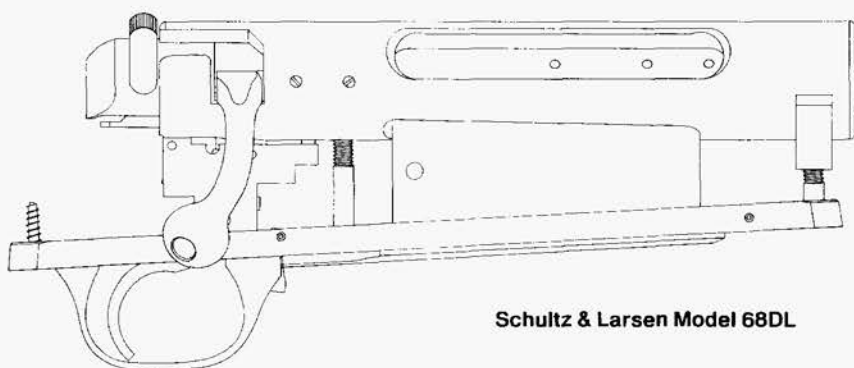
Schultz & Larsen Model 68DL

The Model 68DL, introduced in 1967, was the last of a line of Danish-made Schultz & Larsen high-power sporting rifles whose importation into this country dated back to 1955. The first of these, the Model 54J (Chapter 4), was superseded in 1957 by a Model 60. This somewhat Americanized revision evolved from information brought back from a visit to the 1956 NRA Show by Niels Larsen and his son Fritz.

The Model 60 had some worthwhile improvements over the Model 54J: a forged trigger guard, double-column magazine (and thus trimmer midsection), a three-position safety, and a 3/8-inch longer receiver ring which allowed cartridges a smoother and more gradual feed path into the chamber. It retained a cock-on-closing cam setup, however, plus even adding about an eighth inch to an already rather lengthy firing pin travel. Equally curious, rather than expanding the rifle's chamberings, the Larsens were persuaded on their U.S. trip to limit the chamberings of the Model 60 exclusively to the 7x61 Sharpe & Hart cartridge.

A third generation of the rifle, designated the Schultz & Larsen Model 65, appeared in 1960. In the slow process of trying to successfully adapt their rifle to the U.S. market, the ignition system was finally converted to cock-on-opening. Lock time was also speeded up by cutting firing pin travel back by about one-quarter inch. Finally, the choice of available calibers was doubled, with the addition of the .358 Norma Magnum.

In 1963, a Model 65DL was offered. Although this change in model designation didn't involve any rework to the action, available chamberings were further expanded, with the addition of the .308 Norma Magnum. Later the .243 Winchester, .270 Winchester, .30-06 Springfield, .308 Winchester, .264 Winchester Magnum, and 7mm Remington Magnum were added, finally giving the rifle the advantage of a reasonably complete range of chamberings. By this time also, Norma-Precision had taken over distribution of the rifle from Sharpe & Hart Associates, a seemingly logical move, as Norma



Schultz & Larsen Model 68DL

not only had a good U.S. sales network established, but was also a Scandinavian-based company.

In 1967, Schultz & Larsen brought out what is to date the latest version, the Model 68DL. About then, Norma also decided that, neighbor or not, they would be just as well off without the Schultz & Larsen franchise. There simply wasn't enough sales volume to justify carrying the operation on the books. It was more a problem of getting rifles than finding customers. Production had never been very high, and things were getting worse with time. Schultz & Larsen was reluctant to modernize any of their production methods. They were also losing many of their skilled workers to other companies developing in the Otterup area.

Bob Fessler, a Los Angeles businessman and gun enthusiast, stepped in at this point to take over the Schultz & Larsen franchise. A welding supply wholesaler who handled Western Knives as a sideline, Fessler became acquainted with the rifle by way of his Western Knife representative, who happened to also be a Norma agent. He began by wholesaling the rifles on the West Coast. This seemed to go so well for Fessler that he took over the Schultz & Larsen operation nationwide in 1967, with Norma's blessing.

Garcia briefly considered adding the prestigious Schultz & Larsen name to their line of sporting goods. After visiting Denmark, however, and discovering they would, at best, get but a few hundred rifles per year, they quickly dropped the idea, later picking up the equally prestigious Sako franchise instead. Fessler thus retained his Schultz & Larsen distributorship, although it certainly proved a mixed blessing. He received less than two hundred rifles between 1967 and 1970, when deliveries petered out entirely. This sales volume didn't begin to offset what he invested in testing the rifle, and in advertising.

Schultz & Larsen Model 68DL

The future of these rifles is now problematical. The company claimed a couple of years ago that they may resume production, but that now seems most unlikely. The amount of coverage these sporting rifles have received in gun periodicals over the years belies their actual numbers. Since first imported in 1955, through the last sales in 1970, probably no more than three thousand were ever sold, barely a couple of weeks production of a Remington Model 700 or Ruger M77!



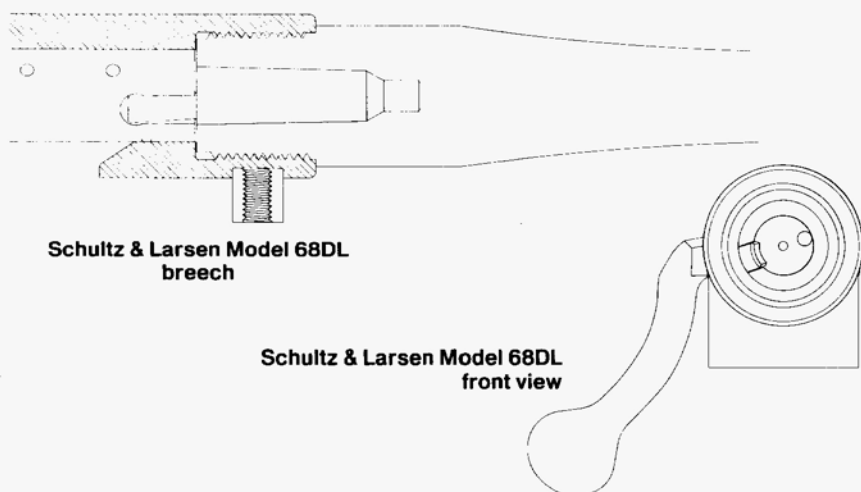
Last of the Schultz & Larsen rifles incorporated several concessions to U.S. market, including cock-on-opening bolt and shrouded bolt sleeve.

The Model 68DL differed from its immediate predecessor, the Model 65DL, mainly in the design of its bolt sleeve. It was now shrouded, with a rear tail added behind the cocking piece to protrude out underneath as a cocking indicator. The safety was changed back to a two-position type. Finally, the number of chamberings offered was increased further, with the addition of the .22-250 Remington, 6mm Remington, 8x57 JS, .300 Winchester Magnum, .338 Winchester Magnum, and .458 Winchester Magnum. With then some fourteen chamberings, the company had perhaps gone a little far to the other extreme.

This rifle retained Uffe Larsen's original cylindrical receiver, but stretched out and opened up, and with a larger recoil lug and much better looking milled steel trigger guard assembly. The close fitting bolt also continued to lock at the rear with four symmetrical lugs, and guide in the receiver by means of a side-mounted pin. A double-column magazine looked a lot different than the earlier single-

Schultz & Larsen Model 68DL

column version, but didn't really function much differently. A bolt lift of less than sixty degrees cocked the mainspring, which in turn drove a rather stout one-piece firing pin forward upon release by a fully-adjustable trigger.



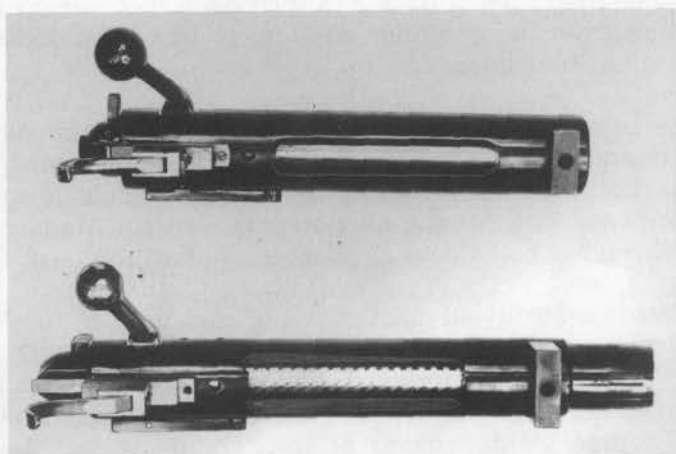
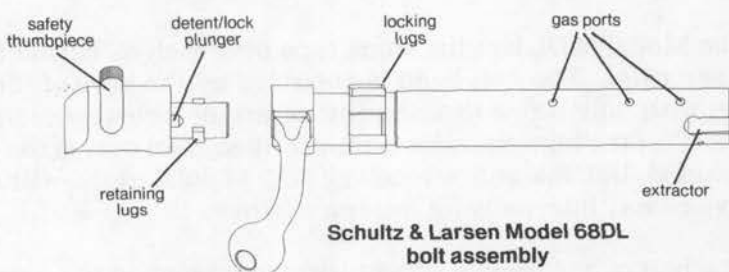
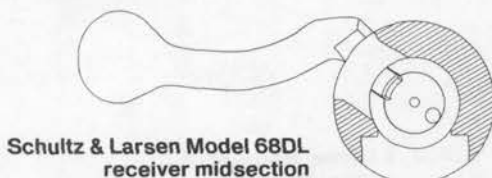
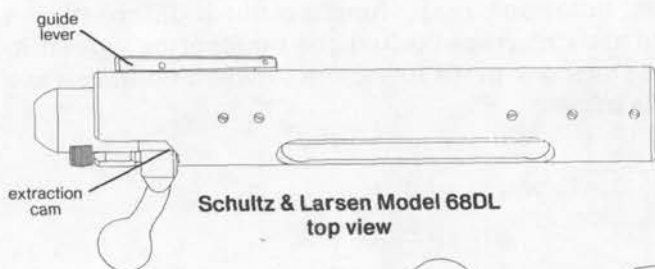
The Model 68DL has the same type of breech as earlier Schultz & Larsen rifles. The bolt head is encircled by the bore of the receiver ring, with only a few thousandths of an inch clearance. A "safety breech" of the highest order is thus formed. Not only is the bolt head shrouded, but the entire receiver ring is solid steel, without being carved away internally for locking cavities.

The bolt of our sample rifle fit within .010 inch of the barrel. Since the bolt-face counterbore is only .113 inch deep, protrusion of the cartridge head from the chamber adds up to less than one-eighth inch, a very favorable figure.

Behind the breech, there are no raceways cut into the receiver boltway to channel and concentrate escaping gas rearward. Gas entering the bolt interior through the firing pin hole is quickly vented by ports opening into the ejection port, as in the Model 54J. In addition, a shrouded bolt sleeve caps off the bolt at the rear.

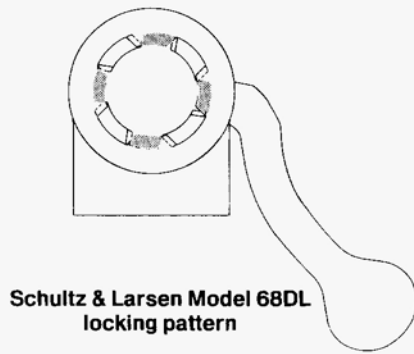
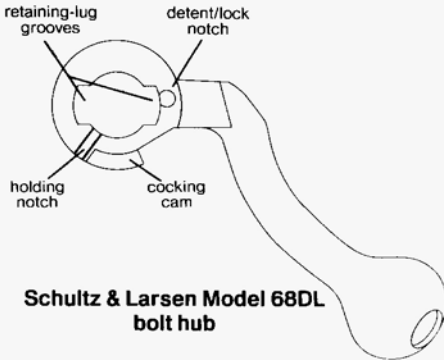
The receiver is a stretched out version of that used in the Model 54J. As cartridges are fed from the magazine, the extra length at the front allows an easier rise forward, and more room to straighten before entering the chamber. By the lengthening process, however, the rifle of course yielded much of the "compactness" that the original version had enjoyed, relative to conventional Mauser actions.

Schultz & Larsen Model 68DL



Model 68DL receiver (bottom) is less rigid than earlier Model 54J (top), due to added length and wider magazine.

Schultz & Larsen Model 68DL



The loading port is cut larger than that in the Model 54J, the idea of contouring this opening to conform to the shape of a cartridge having been abandoned. Underneath, more metal is also removed because of the wider double-column magazine used in the Model 68DL, and so its receiver ends up actually more susceptible to bending and stretching than earlier versions. In the breech area it nevertheless remains extraordinarily strong against expansion, where its thick walls are unweakened by any sort of internal cavities or grooves.

The recoil lug is a simple section of steel plate soldered beneath the receiver ring. Attachment of the trigger and bolt-stop assemblies is by means of removable threaded grommets. Ever since the use of cylindrical receivers has become widespread, there has been the matter of attaching exterior components, since barstock receivers of course lack the integral lugs and bosses of their forged counterparts. Of the many solutions that have so far appeared, these Schultz & Larsen grommets are one of the neatest.

The bolt does not differ greatly from that of the Model 54J rifle. It has a one-piece body machined from steel barstock, then welded together with a cast bolt handle. Like previous Schultz & Larsen rifles, both the bolt and receiver are ground to final dimension after heat treatment, yielding an exceptionally close fit and smooth operation between the two parts.

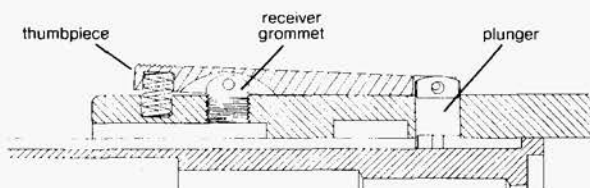
At the rear is a heavy shrouded bolt sleeve, attached by dual lugs. With the bolt open, this bolt sleeve is prevented from accidentally turning out of alignment by engagement between the nose of the cocking piece and a shallow "holding" notch in the rear rim of the bolt. When the bolt is closed, the opposite essentially occurs. The bolt is protected against inadvertent movement, this time by a spring plunger protruding forward from the non-rotating bolt sleeve.

The Model 68DL retains the four-lugged rear locking system of earlier Schultz & Larsen rifles. While its locking rigidity is, if

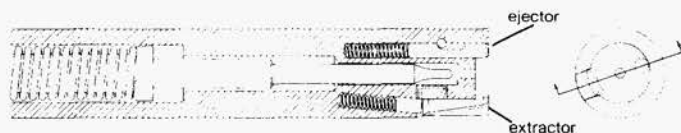
Schultz & Larsen Model 68DL

anything, less than before due to a slightly longer and more opened-up receiver, the differences are relatively inconsequential. Just as very little can be done from a practical standpoint to improve the locking rigidity of a rear-locked action by increasing the thickness of its bolt and receiver walls, it conversely does relatively little harm to open things up slightly. The problem is intrinsic to rear locking *per se*, and is primarily manifested in overworked brass, and sometimes increased bolt operating forces from high pressure reloads. The Model 68DL's brochure recommends the use of specially dimensioned sizing dies for those who handload.

The bolt is guided by a small spring-loaded plunger attached to the left wall of the receiver. The nose of this plunger closely fits a groove milled along the bolt body, giving precise, non-binding control as the bolt moves back and forth. This precision plunger also serves as the bolt stop, and for this purpose is perhaps a little on the skimpy side to absorb the battering of a bolt drawn sharply to the rear.



**Schultz & Larsen Model 68DL
combination bolt guide and stop**

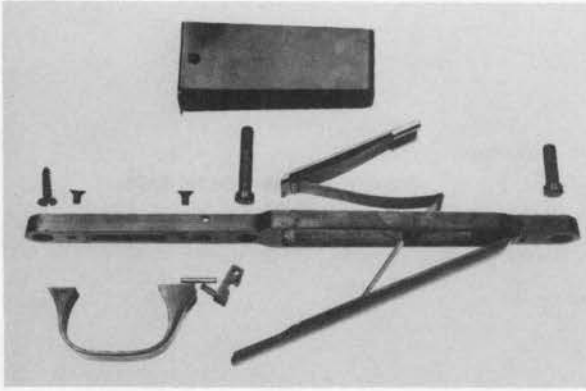


**Schultz & Larsen Model 68DL
bolt-head details**

An extractor and ejector fit opposite each other inside the bolt face counterbore. The ejector is a simple spring-powered pin, while the extractor is a small precision hook, retained by an angled foot at its base and actuated from behind by a spring-loaded plunger.

A quality milled trigger guard probably did more than any other single change to improve the looks of this action over the earlier versions, and the Model 68DL does indeed make up into a very handsome rifle. The trigger bow, cut separately from a solid steel blank, attaches to the machined floorplate frame by means of two Allen-head screws. The bottom is closed off by a hinged floorplate

Schultz & Larsen Model 68DL



Trigger guard and floorplate assembly are formed from milled steel parts. While magazine appears to be of conventional design, it is in fact not functionally equal to Mauser system.

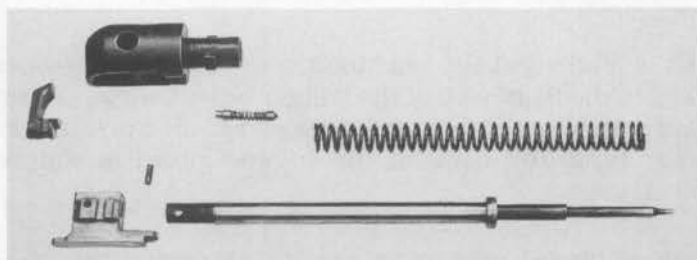
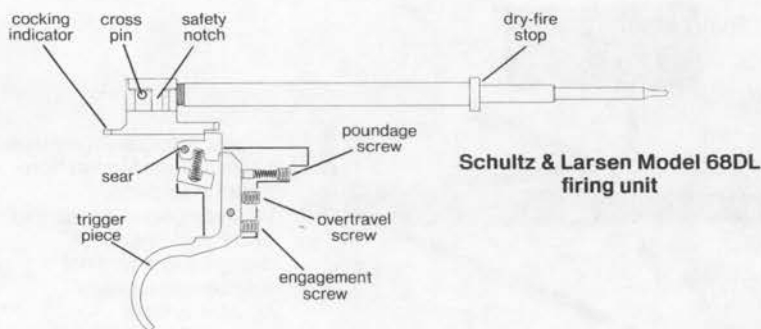
which is latched at the rear by a convenient thumb-operated catch housed in the front web of the trigger bow. Two guard screws fix the trigger guard assembly to the receiver. Because the receiver has no rear tang, the back of the trigger guard is simply held by a wood screw.

A sheet metal magazine box fitted under the receiver stores cartridges in a Mauser-type double-column arrangement. But very little in the way of feed lips are provided. Thus, although the basic elements of a conventional magazine seem to be present, it all functions rather dismally in the Model 68DL, not much better than in the original Model 54J. A narrow receiver port makes it extremely inconvenient to charge the magazine from the top. Cartridges can be dumped in from the bottom like the Model 54J, but that doesn't really work very well either, and jammed magazines seem unavoidable, regardless of what loading method is attempted.

On the positive side, despite a bolt rotation of only fifty-four degrees, operating cams which are very carefully proportioned and precisely machined make possible a smooth-working bolt. The bolt assembly was altered from earlier Schultz & Larsen rifles so that the mainspring cocks on opening. This resulted from cutting a deeper cocking notch in the bolt rim, while at the same time reducing the travel of the firing pin. Only on the initial closing motion is any serious hesitation now encountered, caused simply by a failure during manufacture to properly radius the holding notch in the bolt rim.

The firing pin is proportioned more conventionally than the one used in the Model 54J. Instead of an exaggerated needle-like nose, the mainspring flange is positioned far enough forward to allow adequate space behind it for a normal-sized mainspring. The firing

Schultz & Larsen Model 68DL



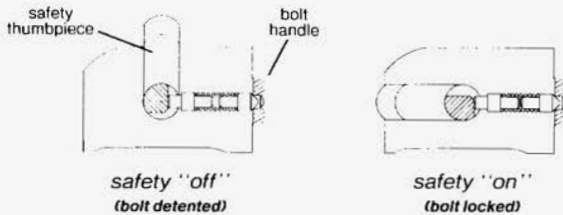
Model 68DL is laid out to allow a normal-sized mainspring, yet hefty firing pin shaft slows lock time.

pin is also heavier and sturdier, perhaps a little more so than necessary, as it also ends up weighing considerably more than the earlier design. Thus, although the Model 68DL has a short striker fall and strong mainspring, lock time is not particularly fast — about 3.3 milliseconds. Had weight been controlled more carefully, the Model 68DL could easily have joined the ranks of most other bolt actions of recent years, with a lock time in the two to three millisecond range.

Because the bolt sleeve is shrouded, the threaded-on cocking piece obviously can no longer be locked from turning on the firing pin by simply driving in a cross pin. Various locking schemes have been used under such circumstances, perhaps most often a setscrew threaded under the cocking piece, and the fanciest the ball bearing arrangement found in Weatherby's Mark V rifle. Schultz & Larsen used probably as simple a solution as any; they stuck with a cross pin, but drilled the hole oversize so that the pin can simply drop in and out of place. The hole in the side of the bolt sleeve for the safety spindle serves as the access for this pin. In the assembled bolt, the pin is of course captured, and functions just as efficiently as if it were driven tightly into place.

Schultz & Larsen Model 68DL

The two-position safety directly engages the cocking piece. It consists of a thumbpiece and spindle journaled into the side wall of the bolt sleeve. Two separate cams are cut into the spindle. With the thumbpiece rotated backward, the inner cam engages a vertical slot in the cocking piece, camming the firing pin assembly back about .035 inch. This frees the sear to rise fully off the trigger, ensuring that the firing mechanism can never inadvertently jam. Simultaneously, the second cam forces a pin forward to block rearward movement of the bolt detent plunger, thus transforming this spring plunger into a positive means to lock the bolt down against accidental lift.



Schultz & Larsen Model 68DL
operation of bolt detent/lock plunger

Except for slight changes in the shape of some of the parts, the Model 68DL trigger is the same as that used in the Model 54J. The trigger piece and sear both pivot inside a sturdy milled-steel housing, attached to the receiver with a cross pin and setscrew. Engagement and overtravel of the trigger are regulated by small setscrews positioned below and above its pivot. Near the top of the trigger housing, a small adjustable spring-plunger combination pushes back against the head of the trigger piece to regulate poundage.

Summary

The Schultz & Larsen Model 68DL is clearly one of the strongest and best finished bolt actions ever produced. Except for its magazine, functioning is quite satisfactory. Everything is precision-machined steel. It is also one of the safest bolt action rifles from the viewpoint of handling gas release. Being a rear-locked action, however, it stretches during firing, allowing the brass of the cartridge case to "work" more than would be otherwise necessary, and thus making it, for handloaders at least, a far less than ideal rifle.

The following summarizes the strong and weak points of the Model 68DL action:

Schultz & Larsen Model 68DL

Strong points:

1. Strong breeching and gas handling.
2. Deep barrel tenon.
3. Strong locking lugs and receiver ring.
4. Rigid and easily bedded receiver.
5. Fully adjustable trigger.
6. Direct-acting safety.
7. Shrouded bolt sleeve.
8. Milled steel parts.
9. Bolt handle detent.

Weak points:

1. Rear locking.
2. Jam-prone magazine system.
3. Difficult-to-load magazine system.
4. Lack of override bevel on bolt stop.

Schultz & Larsen M68DL Dimensions

OPERATING

Extraction: set-back — .10 in.
leverage — 8 to 1

Chambering: cam-forward — .10 in.
leverage — 8 to 1

Bolt rotation — 54°

Bolt travel — 4.28 in.

Cock-on-opening: .255 in.

Mainspring compression proportioned as follows:

opening — .225 in.

closing — .030 in.

IGNITION

Firing pin travel: at impact — .190 in.
dry-fired — .255 in.

Lock time — 3.3 ms.

Impact velocity — 11.1 ft./sec.
energy — 62.9 in.-oz.
impulse — .94 oz.-sec.

Striker/firing-pin hole diameters — .076 in./0.078 in.

Schultz & Larsen Model 68DL

RECEIVER

Overall length — 7.86 in.
Length of loading/ejection port — 3.75 in.
Ring/bridge diameter — 1.335 in.
Barrel threads — 26x1.8 (metric)
Recoil-lug bearing area — .60 sq. in.
Guard screws (metric) — M6x1
Scope-mounting screws — 6x48

BOLT

Lug shear area — .570 sq. in.
Lug bearing area — .088 sq. in.
Bolt diameter — .747 in.
Lug undercut diameter — .700 in.
Lug diameter — .940 dia.
Bolt-face counterbore depth — .113 in.

MAGAZINE

Length — 2.88 in. (.22-250)
 3.40 in. (unblocked)
Capacity: .22-250 — 4
 7mm Rem. Mag. — 3

WEIGHT

Receiver group	25.5 oz.
Bolt group	16.4 oz.
Magazine/floorplate group	10.7 oz.
Total action weight	52.6 oz.

Ruger Model 77

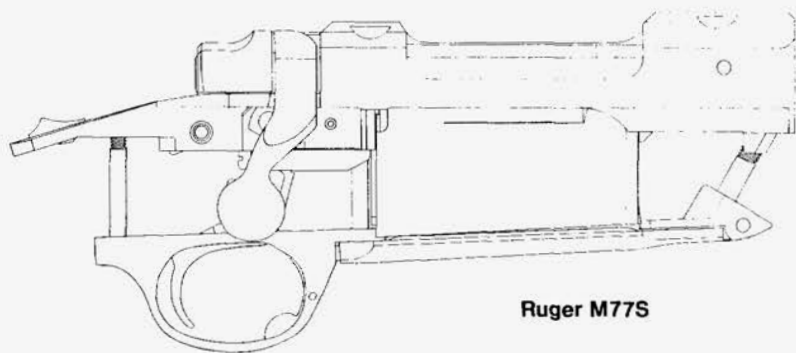


From modest beginnings in a small wood-frame building adjacent to the Southport, Connecticut, railroad station, Sturm, Ruger & Co. has grown into one of the world's leading manufacturers of sporting arms. It started as a partnership in 1949 between ordnance designer Bill Ruger and artist Alexander Sturm, who drew the heraldic eagle logo and supplied the original \$50,000 working capital.

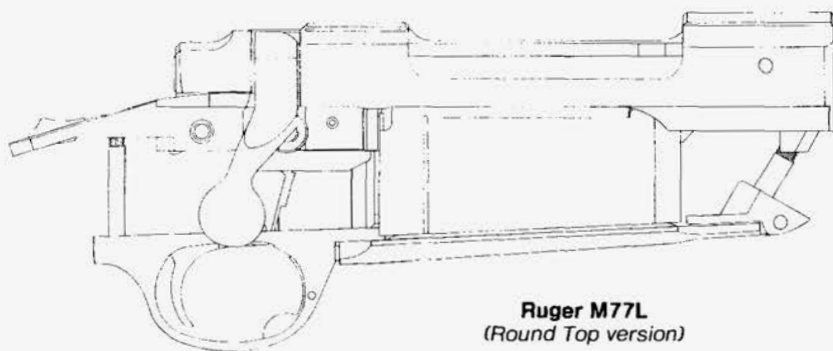
Initially offering only a smallbore autoloading pistol, the Ruger line carefully expanded through the years under Bill Ruger's close stewardship to include a variety of handguns, plus a couple of autoloading carbines. A high-power single-shot rifle, the Ruger Number One, was added in 1961. Early in 1965, the bolt action rifle project began, an idea that Bill Ruger had by then been mulling over for several years.

Jim Sullivan, an engineer who prior to joining Ruger had experience working on the development of automatic weapons at Cadillac Gage, did the yeoman design work for Ruger on the new rifle. Despite its apparent mechanical simplicity, Sullivan found to his surprise that the design of a bolt action can be as challenging and time-consuming a project as any machine gun he had ever worked on, demanding exacting attention to every detail from an aesthetic as well as functional viewpoint. The design was laid out under Bill Ruger's watchful eye at Southport, while all manufacturing of the rifle is at Pine Tree Castings, a Ruger facility up in the ski country of central New Hampshire. Besides the overseeing role of Bill Ruger, others contributing to the rifle's development included Lenard Brownell, Larry Larson and Harry Sefried. Larson and Sefried were primarily involved later, after Sullivan left in 1968, in developing a long or "magnum" version of the rifle.

As soon as the first pilot run of one hundred rifles was completed in the summer of 1967, Sullivan went up to Pine Tree for a final wring out of the design, including tests of the locking lugs and gas ports. A very limited production thereupon began later that fall.



Ruger M77S



Ruger M77L
(Round Top version)

While the rifle was shown at the Boston NRA Show the next spring, even in 1968 less than fifteen hundred rifles were made. That figure jumped to just over ten thousand the following year. It almost doubled again in 1971 after introduction of the long-receiver magnum version, and has since been rising steadily, so that it is now the second best selling high-power bolt action rifle in the U.S., overtaking every other make but the perennial best selling Remington Model 700.

A widely-circulated and very charming story holds that the rifle was Ruger's 77th design project, accounting of course for its designation. Actually, the process was more prosaic. The Model 77 label, later shortened to M77, emerged from a marketing session at Southport. Since the two most successful U.S. bolt action rifles at the time (Remington's Model 700 and the Winchester Model 70) both featured the numeral 7, "Model 77" simply seemed an overwhelmingly appropriate choice for the new rifle.

Bill Ruger's love for classic gun design, combined with his knowledge of investment casting and production engineering, molded the success of the Model 77 rifle. He deliberately turned

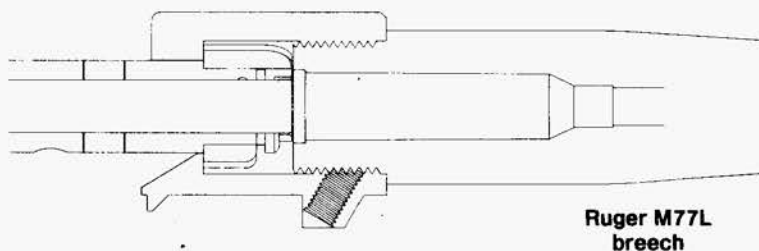
Ruger Model 77

back many decades, utilizing features few considered to still be entirely practical, such as an external Mauser extractor and box-like bolt stop. The result was a "classic" gun put together with very "modern" technology. Also, a great deal of attention was devoted to appearance, Ruger personally having some very definite ideas about things like how thick a rifle should be, and even how bolt handles should be shaped.

The action not only comes in two lengths, but two distinct styles, one of which features integral scope bases. Its "siderail" receiver has a fixed recoil lug, plus a contoured tang extending gracefully to the rear to accommodate a "shotgun" style sliding-button safety. While its underside recoil lug is small, it is solidly seated by a special angled guard screw. The bolt has an integral handle, and three huge gas ports. A special guide lug on the side resembles that used in the old Winchester Model 70 bolts, except Ruger's didn't inhibit manufacturing efficiency because it is swaged into place.

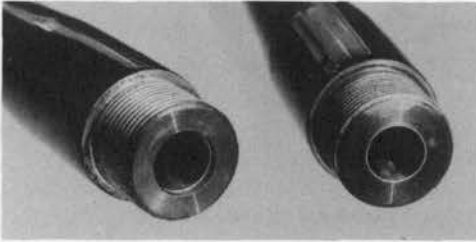
Six patents were issued to Ruger pertaining to features in the Model 77 rifle:

<i>Patent</i>	<i>Inventor</i>	<i>Subject</i>
Des. 218,304	Ruger	bolt handle
3,444,641	Ruger	angled guard screw
3,577,668	Ruger-Sullivan	trigger-safety
3,611,606	Sefried-Sullivan	integral scope bases
3,621,598	Ruger-Sullivan	bolt stop latch
3,668,800	Sefried	riveted guide lug

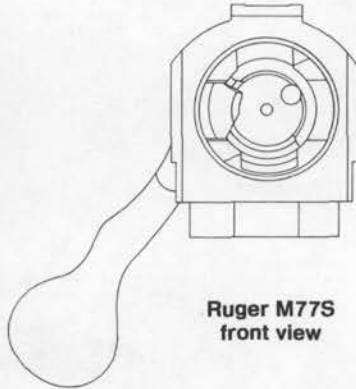


The external non-rotary extractor led to a breech layout somewhat reminiscent of the days of the Mauser and Springfield rifles. While the M77's main bolt-head rim walls are .122 inch high, and fit close to the barrel, the rest is cut back to a height of only .035 inch in order to clear the non-turning extractor head. Thus, instead of a modern "counterbored" bolt face, the M77 bolt

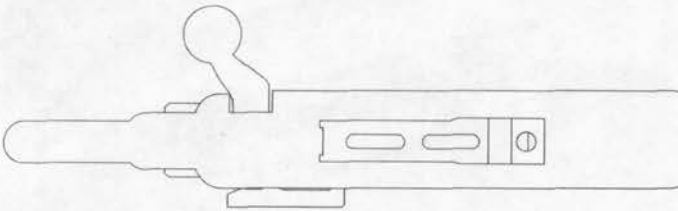
Ruger Model 77



Barrels chambered for both magnum and standard cartridges have sharp and clean entrances, helping minimize head protrusion.



Ruger M77S
front view



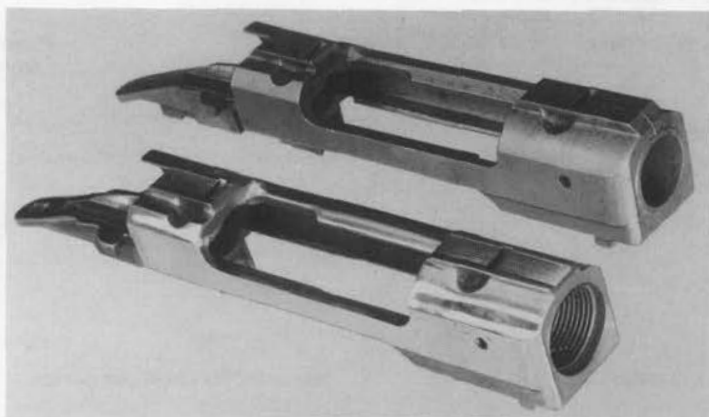
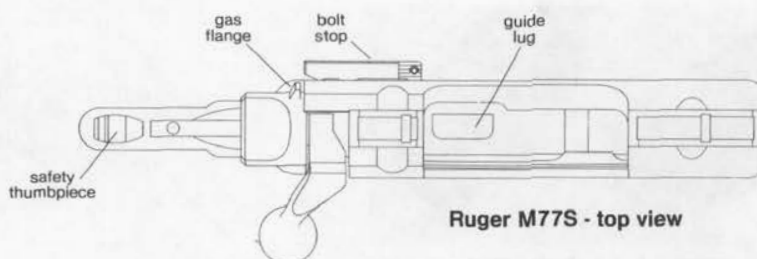
Ruger M77S - bolt gas ports

only partially shrouds that portion of the cartridge head which protrudes from the barrel.

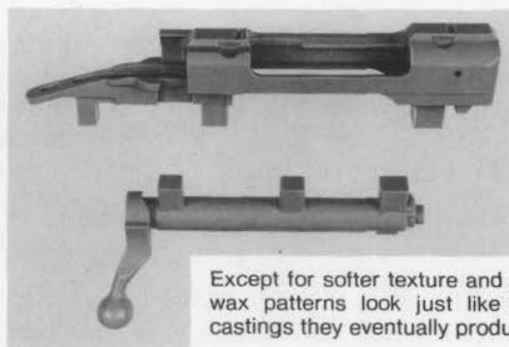
In evaluating the M77, some writers have automatically concluded that because of its non-rotary extractor it also shares Mauser's minimum cartridge protrusion (.105 inch). That was in fact one of Sullivan's initial design goals. However, for reasons examined later in this chapter, the head of Ruger's extractor ultimately ended up too thick to allow seating cartridges into the barrel as deep as Mauser did.

A small gas port is positioned in the side of the receiver ring next to the extractor head. As is often the case, it was spawned by the marketing department, which well understood the endless criticism that arises when visible gas ports are omitted in a new rifle design. Any gas escaping rearward inside the receiver is blocked by the flange portion of the bolt stop, then by a small special gas flange projecting from the rim of the bolt sleeve. The bolt interior releases pressure directly into the magazine by way of three downward-facing gas ports. While much praise has been heaped on these large ports, in fact their primary reason for being is to facilitate casting the bolt hollow, by serving as natural braces to position the long, thin ceramic core as the molten steel is poured.

Ruger Model 77



Raw receiver casting (top) requires relatively little machine work before it is ready for bluing (below). Like all previous Ruger rifles, M77 receiver is flat sided to allow inletting the stock with the vertical routers at Pine Tree.



Except for softer texture and robin-egg blue color, wax patterns look just like the AISI-4140 alloy castings they eventually produce.

The receiver is investment cast, a process which allowed more design freedom than is possible when a great deal of machining is involved in generating shape and form. Thus, in the M77, the recoil lug, upper trigger housing, extended rear tang, and even the magazine guide lips, are an integral part of the receiver. A careful series of steps take the raw casting to a finished part. After breaking off the ceramic mold, the gates and runners are cut and ground away. These exposed surfaces give the first indication of

Ruger Model 77



A special fixture measures critical points along the length of each receiver casting. After a quick scan of the dial indicators, it is slapped into a vise and straightened with a mallet and steel bar. Workmen become so skilled that this "massaging" seldom needs to be repeated. Precision gage bars then check clearance of internal passages.

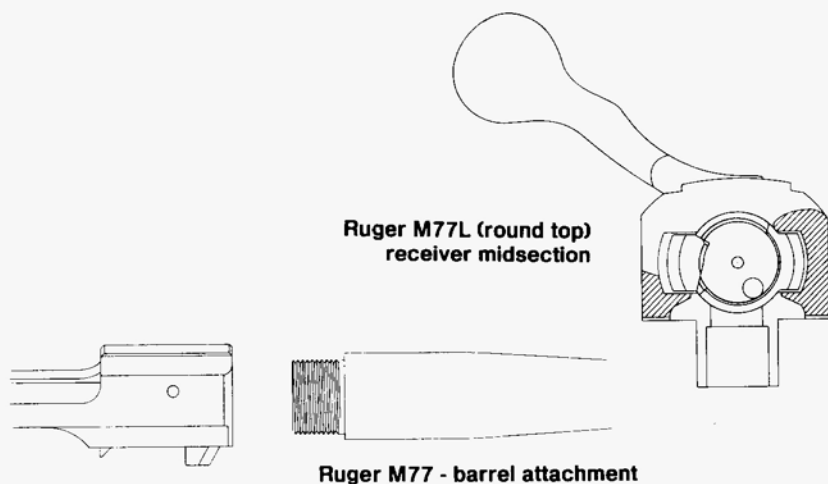
whether or not the casting is sound. The good billets are then furnace annealed in a carbon atmosphere which not only renders a soft and uniform metallurgical structure, but restores the surface carbon burnt away when the casting was poured.

The castings are then magnafluxed. Any minor defects located on surfaces which can be readily refinished are weld repaired. Otherwise the casting is scrapped. All castings surviving this phase are straightened. Every receiver, and bolt for that matter, requires at least some straightening due to the fact that each billet cools in a slightly different manner.

The receivers are now ready for what little machine work is required. All cam surfaces, as well as the raceway channels along each side of the receiver, are left in the as-cast condition. Consequently, broaching the basic boltway to final diameter, and cutting the barrel threads and locking-seat faces into the receiver ring completes most of the interior machining operations. The exterior is much the same story. The three surfaces under the casting gates are milled flat. Except for a few additional areas associated with the magazine feed lips, the safety, and the scope bases, the rest of the receiver exterior is finished by hand on a series of large belt sanders.

As they come from the foundry area, with only the gates removed, the short and long receiver castings weigh 18.6 and 19.8 ounces respectively. After finish machining, these figures are 15.5

Ruger Model 77



and 16.7 ounces. Thus, barely three ounces of steel is machined off these precision castings, quite a contrast to something like the pre-'64 Model 70 receiver, where roughly one hundred ounces was hogged off of each raw rectangular billet. The finished receivers are hardened by Martempering, a low-distortion neutral-salt process roughly comparable to the Austempering method used by Remington and Winchester. Repolishing and bluing then completes work on the receiver.

The receiver ring has extra metal on the right side to compensate for the offset extractor. Instead of a Springfield-like pad, however, the entire right side of the M77 is brought out approximately .025 inch extra from centerline. Without this shift, thickness of the right receiver wall would have been less than .100 inch, down close to where Paul Mauser found himself after he invented the external extractor, but before going to large-ring receivers to compensate.

There are two receiver lengths and two styles. The original short length (M77S) version has a patented system of integral scope bases which not only reduces scope height, but also strengthens the cross section of the receiver ring. When the long (M77L) version was introduced in 1970, it offered in addition a "round-top" style, drilled and tapped for conventional scope bases. Because of lower sales volume for the short rifles, this round-top variation has been made available, so far, only in the long receiver.

The "magnum" receiver is not simply longer, it is reproportioned as well. In laying out this later design, Harry Sefried lengthened the bridge by about a quarter inch, at the same time shortening

Ruger Model 77



The interior cavity and the gas ports are cast into the M77 bolt. Thus, like the receiver, relatively little metal removal is necessary.

the rear tang by a corresponding amount. The net effect adds just enough extra guiding length to better stabilize the bolt at the beginning of the closing cycle.

While the recoil lug under the receiver ring is relatively small, optimum advantage is gained from what cross sectional surface it does have. The patented front guard screw works on a rearward diagonal of thirty degrees to physically draw the lug back into full contact with the stock.

Like the receiver, M77 bolts are investment cast from alloy steel. Casting allows an integral bolt handle, a feature not overlooked in numerous Ruger ads. The hollow interior is simply reamed and threaded, while the outside diameter is finished on a precision grinder. As the operator feeds the huge wheel across the bolt, its side ends up also finishing the bearing faces of the locking lugs. By use of a dial indicator fitted to the grinding spindle, the locking faces can be held within .0005 inch relative to the face of the bolt.

Sliding movement of the early M77 bolts wasn't particularly smooth. One reason was that the rough "as-cast" raceways add drag compared to raceways cut into receivers. Several polishing techniques have been tried at Pine Tree, including an abrasive slurry pumped through the boltway, but none have thus far been adopted. They don't pull a cleanup broach through the raceways, simply to avoid truncating the receiver ring threads on the way out.

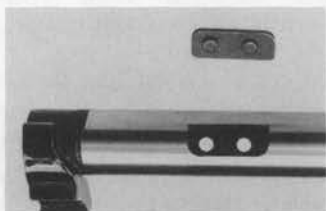
But actually a greater problem than roughness was the fact that Ruger's casting process leaves about two or three times more clearance around the locking lugs than in a machined receiver. Thus, after about six months production, Harry Sefried added a guide lug to the bolt body. Helping to stabilize the bolt on the initial opening cycle, it closely resembles that used for many years in the classic (pre-'64) Winchester Model 70 rifles, except Sefried's was not machined integral.

Ruger Model 77



M77 bolt (top) bears general resemblance to that of Winchester pre-'64 Model 70 (bottom). Model 70's guide lug, however, was integral, greatly complicating machine work on the bolt body. Ruger's is swaged in place after bolt is ground to final diameter.

Swaged-on guide lug stabilizes bolt.
Fancier version hollowed out for a
tiny roller bearing was tried,
but never adopted.



Ruger takes advantage of the big gas ports on the opposite side of the bolt to swage this guide lug in place, the exact same thing Remington did in the 1930s and 1940s in attaching a Mauser-like guide lug to the bolt of their Model 30S and 720 rifles. Because the guide lug is an attachable part, the bolt body can be first ground separately to dimension as a pure cylinder, rather than having to machine around the lug in a slow and costly attempt at approximating a cylindrical surface, as Winchester did for so many years.

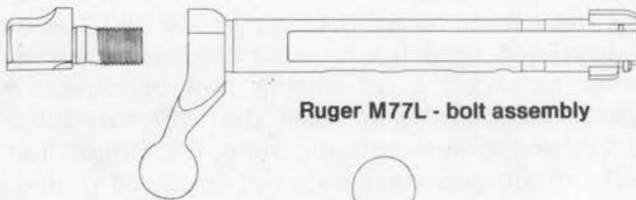
The lug is carburized before installation. This "absorptive" heat treatment process permits selecting which surfaces are hardened and which are not. These lugs are dipped in copper immediately upon leaving the foundry, so that later grinding the casting gates off the bottom of each one not only finishes the actual running surface to final dimension, it simultaneously removes the copper plating from that area. Thus, only the "working" surface absorbs carbon during heat treatment, the others remaining soft enough for the subsequent swaging and finishing operations.

Early into the design of the new rifle, Bill Ruger came across what he describes as a "dog-leg" bolt handle on the cover of a British gun magazine. He brought the magazine into the engineering department, so that the handle of his new rifle could be patterned in a similar manner. What finally evolved was less

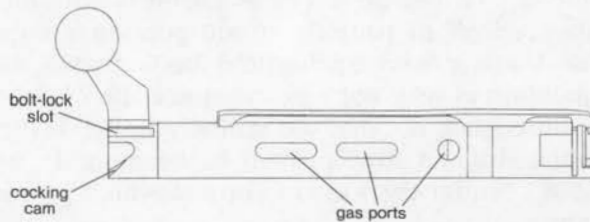
Ruger Model 77

extreme than the British inspiration, with a rather small knob flaring sharply forward to give an angular, if not a true "dog-leg" effect. Ruger felt it was unique enough to be patented (Des. 218,304). This enthusiasm was shared by few others within the company, however. The same applied to customers, and it was in fact one of the least popular features of the new rifle.

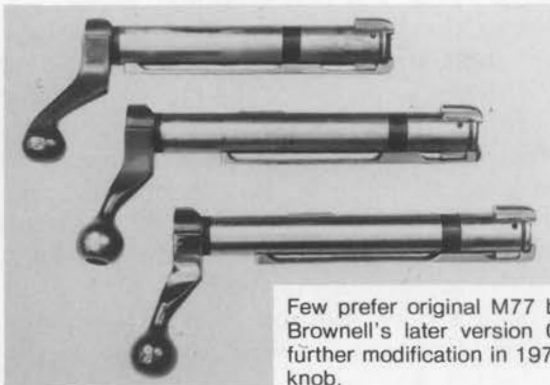
In 1970, shortly after the M77L was introduced, Lenard Brownell, in whom Ruger trusted more than anyone else on matters of taste, finally convinced him that a change in the style of the bolt handle might be worth considering. Ruger thereupon challenged Brownell to show him a better design. It so happened that Brownell had just finished work on a new bolt handle which he planned to use and market when he returned to his custom rifle business in Wyoming. Thus it was simply a matter of taking a rifle down to the shop, sawing off the old handle, and welding on one of Brownell's. Ruger approved the change the next day, and so the M77 rifles got Brownell bolt handles, a more graceful, as well as easier to grasp, design.



Ruger M77L - bolt assembly



Ruger M77L - bolt underside



Few prefer original M77 bolt handle shape (top) to Len Brownell's later version (below). To facilitate casting, further modification in 1971 (bottom) eliminated hollow in knob.

Ruger Model 77

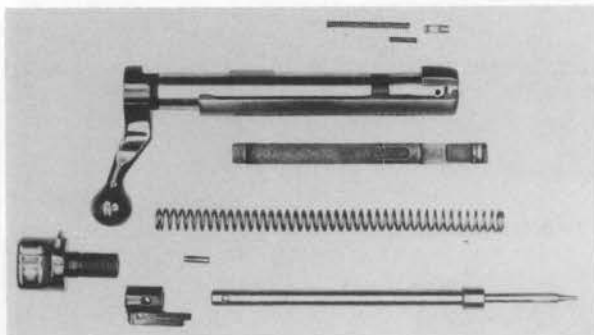
The bolt face also underwent change. Its counterbore diameter was originally .480/.486 inch for standard (.473 inch) cartridges, and .538/.544 inch for belted magnums (.531 inch). These figures gave the cartridge head an average diametrical clearance of around .010 inch, pretty much typical in the industry, and normally adequate to ensure smooth bolt operation, taking into account tolerances in the construction of the cartridge, as well as concentricity within the action itself.

This proved inadequate in the M77. At Pine Tree they don't reference on the boltway when threading the receiver ring, and thus the counterbore in the bolt face and the chamber in the barrel don't always line up perfectly in the assembled rifle. There was sometimes so little net clearance that expanded cartridge heads could bind the bolt. In 1976 the counterbore diameters were opened up to give almost three times the original clearances. While this has eliminated binding, the bolt rim obviously no longer supports the cartridge head circumference to quite the extent many shooters assume.

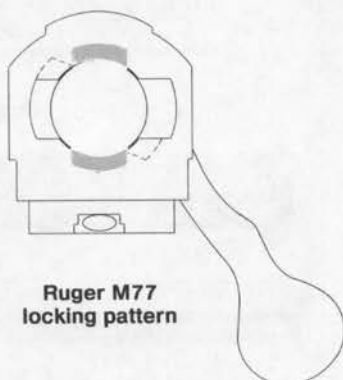
The locking lugs are shaped something like those of the pre-'64 Model 70, with a long lug extending all the way to the bolt rim on the left side, and a shortened right lug capable of clearing underneath the non-rotating extractor head during bolt opening. A great deal was made of their strength when the M77 was introduced. Tested on a Tinius Olsen tensile machine, the Ruger lugs sheared off at roughly 40,000 pounds, compared to 29,000 pounds for Mauser and Springfield bolts tested alongside. An obvious question is why not also compare the M77 with some of its current competitors, not just old military bolts. It turns out that it was, but since Ruger's lugs proved to be roughly on a par, these results didn't render the kind of copy of which promotional campaigns are made.

As part of the rifle's "classic" look, Bill Ruger wanted a Mauser-like bolt stop latch hinged to the left outer wall of the bridge. However, whereas Mauser's bolt stop required special mounting flanges machined integral with the structure of the receiver, Ruger ultimately got by with merely drilling and tapping the receiver wall. An eccentric hole in the M77 bolt stop latch allows it to simply pivot on the head of a machine screw. Ruger considers this patented design to be perhaps the best single piece of engineering in the rifle. Besides its simplicity of construction, the latch return spring even acts to cushion the momentum of the bolt. Only after some spring compression occurs does the bolt stop flange make solid contact with the receiver, thus saving wear and tear on the left locking lug of the bolt.

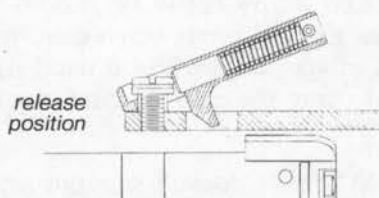
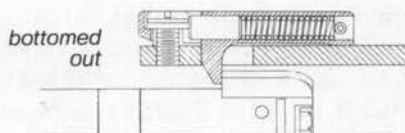
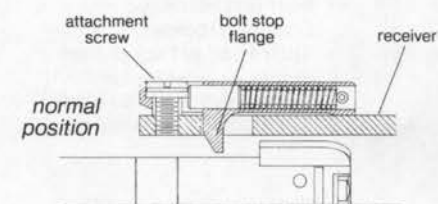
Ruger Model 77



M77's bolt assembly consists of mostly investment castings and screw machine parts. Small flange on left side of bolt sleeve was last minute addition following gas-blowback tests conducted at Pine Tree in 1967.

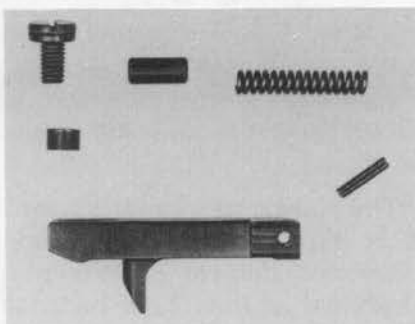


**Ruger M77
locking pattern**

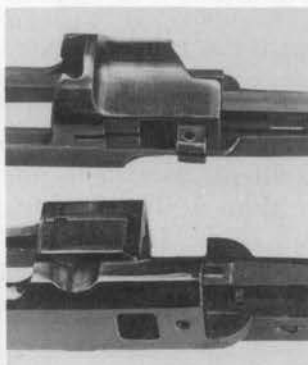


**Ruger M77
operation of bolt stop**

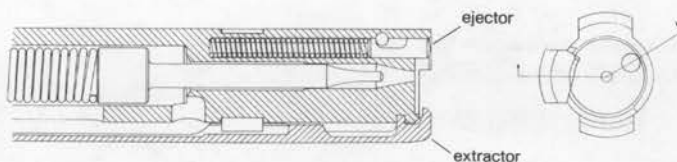
Whereas bolt stop in Mauser 98 required intricately milled attachment flanges (top), Ruger's M77 accomplished the same result with a simple drilled and tapped hole (bottom).



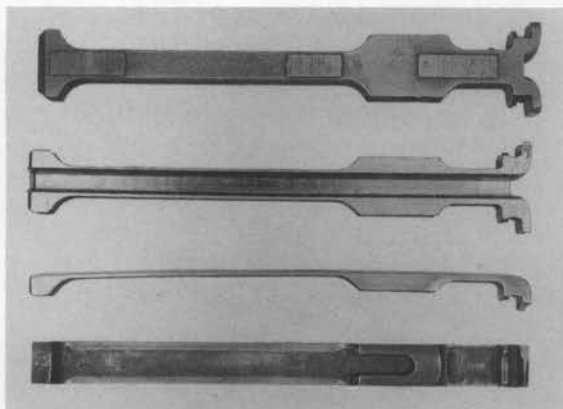
M77 bolt stop, consisting of an investment casting and several screw machine parts, attaches to receiver by means of a simple machine screw. Serrated tab aids in swinging latch out for bolt removal, while rear bevel on stop flange allows pushing bolt directly back into the receiver.



Ruger Model 77



Ruger M77 - bolt head details



Extractors are cast in pairs. After splitting with a milling cutter, they are bent and hardened into final form (below). Their head is thicker than that of a pure Mauser extractor, shaped to readily close on a chambered round.

The classic rifle criteria also led to the use of a Mauser extractor. This type of extractor, which generously contributed to the economic demise of Winchester's original Model 70 rifle, was practical at Pine Tree because of their skills in the art of investment casting. Casting them back-to-back in pairs avoids the need to mill out the details on the inner surface of each extractor. After the M77L was introduced, even more production time was saved when it was discovered that Enfield extractors could be modified to fit the longer bolt. For several years Enfield parts were used for these bolts. But as available surplus stocks began to be used up, the economic advantages diminished, and the use of cast parts was eventually phased in again.

Despite the external extractor, the M77 bolt doesn't engage and control each cartridge as it emerges from the magazine box as in a Mauser rifle. While such a system was originally contemplated, the design of the magazine feed lips then becomes very critical, and Sullivan needed to adapt the M77 to a variety of cartridges, rather than a single cartridge style as in the case of the classic military rifles. He was well aware that the cost of milling a series of elaborate feed lips underneath the receiver was another big factor in the undoing of the old Winchester Model 70.

Thus, each cartridge is simply pushed into the chamber. The

Ruger Model 77

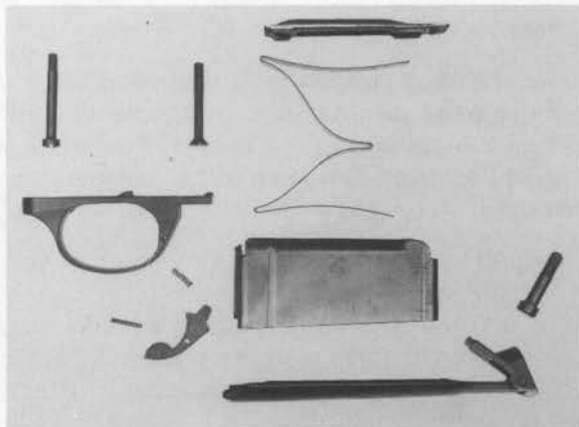
head of the extractor is made thick enough to incorporate an angle on its face which can readily cam over the rim of the cartridge upon final closure.

By running cartridges in front of the bolt, they can better seek their own path into the chamber, and the guide lips take on less importance. Further, while the feed process may not be as carefully controlled as in the classic Mauser system, it is freer and smoother, with less binding tendencies. This type of feed also allows use of a simple pin ejector in the bolt face, which is not only cheaper to make and install than the old receiver-mounted blades, but can adapt without alteration to various bolt strokes. There was also no reason to make any part of the M77 bolt rim completely flush with the bolt face as in the Mauser, and so its bottom circumference was cut down only far enough to clear the extractor head.

The magazine box is heavy gauge steel, tack-welded into a solid unit, then heat treated for strength. Pressed-in cartridge guide lips cooperate with shallow lips milled directly into the receiver. The floorplate is a two-piece system like that in the Winchester Model 70. The trigger bow is fixed by the rear and middle guard screws, and the floorplate hinges separately to a small plate under the front guard screw. While this arrangement simplifies inletting of the stock, it fails to control the spacing between the floorplate and its catch with the same precision as in a one-piece floorplate frame.

The magazine follower is cast stainless steel, hollow underneath to cut down on weight, and with an attractive brushed finish on top. Both the floorplate and trigger bow are anodized aluminum, except on the .458 Magnum rifles where cast steel is used. For purists who don't object to the extra three ounces they add to the

Ruger chose two-piece trigger guard of Winchester Model 70, but with much nicer floorplate catch. Assembly of rifles at Pine Tree requires extra care due to lack of one-piece frame.



Ruger Model 77

weight of the rifle, steel parts are also available at extra cost for the other M77L rifles. The steel trigger guards can of course be used for the M77S rifles, although Ruger doesn't cast a short steel floorplate.

Bill Ruger kept particularly close tabs on the appearance of the M77 rifle, which he correctly perceived as ultimately critical to its success or failure. Everything had to fit the overall layout he was striving for, including such things as the offset between the action, trigger and trigger guard, and the location and curve of the pistol grip. He feels that positioning the action forward relative to the trigger guard is necessary for a gracefully styled rifle, and that the M77 came out particularly well in that respect. He also wanted a thin midsection and a four-shot magazine. Sullivan, however, managed to squeeze in a conventional five-shot arrangement compact enough to meet with Ruger's approval, if just barely.

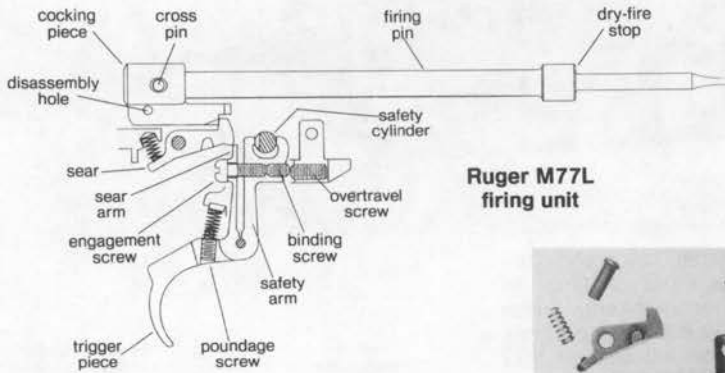
The M77 has a good Mauser-like camming system, with a full quarter-turn bolt lift giving adequate cam leverages and displacements for easy and positive functioning. The fact that the cams are cast rather than machined into the bolt and receiver gave a freer hand in their design, allowing Sullivan to copy the recessed and protected extraction cam of the Springfield M1903 and Winchester Model 70 at essentially no added expense.

The firing pin is made from AISI-6150 steel rod. After rough machining, its tip is hardened, then ground to final tolerances. This is one of the very few M77 parts not actually made at Pine Tree, being manufactured instead to Ruger's specifications by an outside company specializing in screw machine products. Originally a C-washer was used for the mainspring flange, held concentric by a bearing cap, an arrangement much like that in the post-1964 Winchester Model 70. Bill Ruger, however, disliked the looks of the end result, and it was changed to the present one-piece design early in 1968.

The cocking piece is investment cast from AISI-8620 steel, carburized to produce a hard wear-resistant skin, yet tough ductile core. Crosspinned to the rear of the firing pin shaft, it has a small hole in its lower flange to allow inserting a punch or nail for field stripping.

A small sear, pivoted in the receiver, reaches up to block passage of the cocking piece. The sear is in turn supported by a trigger piece pivoted in a cast bracket which is fixed to the underside of the receiver to form a lower trigger housing. This trigger piece is "split," with the rearward "sear arm" directly supporting the sear, and a "safety arm" reaching forward to journal on the safety.

Ruger Model 77



Ruger M77L
firing unit

As elsewhere in the rifle, the trigger assembly is a collection of investment castings and screw machine parts. With engagement screw removed, top arms of trigger piece spring apart. Special care was taken by Sullivan to balance the trigger piece about its pivot, thus lessening susceptibility to jars and bumps.



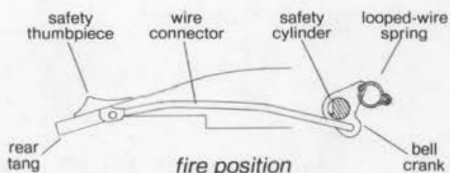
Although the trigger is fully adjustable, Ruger's instruction booklet warns against going below any of the factory settings. Poundage is regulated by an Allen-drive screw in the trigger shoe, which is accessible without removing the stock. Another nice refinement are twelve ratchet notches in the head of the engagement screw. With forty threads to the inch, this screw is thus adjustable in discrete steps of just over .002 inch.

Bill Ruger wanted a tang-mounted sliding safety positioned directly under the thumb. Because geometrically this required some form of linkage system, the camming forces associated with a direct type safety were pretty much ruled out, and instead a "trigger-block" pattern was used. With no way to really avoid the fact that the "holding power" of this kind of safety depends entirely on the relatively small overlap existing between the trigger and sear, Ruger instead optimized the arrangement by eliminating any unnecessary slack between the working parts. Thus, with the safety engaged, almost no movement of the trigger piece is possible, and it remains locked into virtually its original position under the sear.

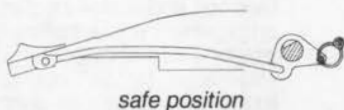
Ruger Model 77



Safety button has "shotgun" location on top of rear tang. Its linkage arrangement, plus mounting of bolt stop assembly, is visible on left side of M77 receiver. Angle of front guard screw helps draw the recoil lug tightly into stock.



**Ruger M77
operation of safety**



While other rifles have incorporated an adjusting screw to remove slack from the safety, these had to be reset whenever trigger engagement was changed. Ruger's patented solution makes this unnecessary. The resilient construction of the split trigger piece allows its two upper arms to actually squeeze together or spread apart with the engagement screw. The yoke-like engagement of the front "safety arm" to the receiver-mounted safety cylinder forms a fixed reference, unaltered when the engagement screw is turned to reposition the "sear arm" either forward or back underneath the sear.

An overcenter bell crank, connected to the tang-mounted thumbpiece by a heavy wire, rotates the safety cylinder to two positions. When the thumbpiece is slid forward, the safety cylinder begins to rotate backward. A small looped-wire spring anchored to the receiver and attached to the outer edge of the bell crank snaps it over to complete the job. This moves a clearance notch on the cylinder to a position which allows full trigger travel. The forward movement of the thumbpiece also exposes a letter "F" engraved on the tang to warn that the rifle is ready to fire.

Sliding the thumbpiece rearward flips the safety cylinder around sixty degrees to block the trigger. (A minimal working clearance

Ruger Model 77

remains, of course. In our sample rifles, full sear overlap was .010 inch. Pulling the trigger against the safety cylinder removed only .002 inch, leaving an .008-inch safety margin.) At the same time, a blade keyed to the right side of the safety cylinder rotates upward to lock the bolt handle, while the letter "S" on the tang is exposed by the thumbpiece.

The serrated thumbpiece on the rear tang is out of the way of any scope eyepiece, and its central location is convenient for either right or left-hand operation. Functioning is both smooth and convenient, although not completely silent due to the snap-over action of the loop-wire spring.

Summary

Every gun designed at Southport bears Bill Ruger's personal stamp. More so than the head of any other large firearms company, he is interested in even the most minute detail of design and production. Ruger had very strong ideas about what a bolt action bearing his name should look and function like, and had for years been turning away outside inventors who wanted their brainchildren built under Ruger's logo.

Every aspect of the M77 was scrutinized countless times during its development, changed and rechanged. While this can be frustrating in the extreme to the employees on the payroll, the end result in this case speaks for itself. The M77 rifle is a very solid performer, both on the marketplace and in the field. It now in fact trails only the Remington Model 700 in popularity, a remarkable achievement in this highly competitive field.

Because of Ruger's meticulous attention to detail, it's pretty difficult to find any glaring weaknesses in the M77. On the other hand, there are few important innovations either. But numerous details in the rifle subtly improve earlier approaches, and everything is blended together with consummate taste and judgment into one of the best bolt action designs available today. The following summarizes the action's strong and weak points:

Strong points:

1. Handsome and well proportioned lines.
2. One-piece bolt with integral bolt handle.
3. Fully adjustable trigger.
4. Positive extractor system.
5. Attractive and effective bolt stop.
6. Conveniently located safety thumbpiece.
7. Angled front guard screw.

Ruger Model 77

Weak points:

1. Two-piece floorplate assembly.

Ruger Model 77 Dimensions

OPERATING

Extraction: set-back — .08 in.

leverage — 8.5 to 1

Chambering: cam-forward — .13 in.

leverage — 8 to 1

Bolt rotation — 91°

Bolt travel: M77S — 4.11 in.

M77L — 4.55 in.

	M77S	M77L
Mainspring compression: opening	.291 in.	.272 in.
closing	-.016 in.	.012 in.
total	.275 in.	.284 in.

IGNITION

	M77S	M77L
Firing pin travel: at impact —	.217 in.	.231 in.
dry-fired —	.275 in.	.284 in.

Lock time (ms.)	3.4	3.6
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Impact velocity (ft./sec.)	11.9	11.7
energy (in.-oz.)	62.3	65.5
impulse (oz.-sec.)	.87	.93

Striker/firing pin hole diameters — .073 in./0.077 in.

RECEIVER

Overall length: M77S — 9.06 in.

M77L — 9.52 in.

Length of loading/ejection port: M77S — 2.73 in.

M77L — 3.17 in.

Ring cross-section: width — 1.316 in.

height — 1.385 in.

Barrel threads — 1 - 16 UN

Recoil-lug bearing area — .22 sq. in.

Guard screws: front — 1/4 x 28

middle and rear — 10-32

Scope-mounting screws — 6x48

Ruger Model 77

BOLT

Lug shear area — .445 sq. in.

Lug bearing area — .104 sq. in.

Bolt diameter — .694 in.

Lug heights: left (top) — .125 in.
right (bottom) — .106 in.

Bolt-face recess — .119 in.

MAGAZINE

Length: M77S — 2.93 in.

M77L — 3.38 in.

Capacity: .243 Winchester — 5

7mm Remington Mag. — 3

.220 Swift — 4

WEIGHT

	M77S	M77L
Receiver group	18.0 oz.	19.4 oz.
Bolt group	12.8 oz.	13.9 oz.
Magazine/floorplate group	7.0 oz.	7.5 oz.
Total action weight	37.8 oz.	40.8 oz.

Champlin

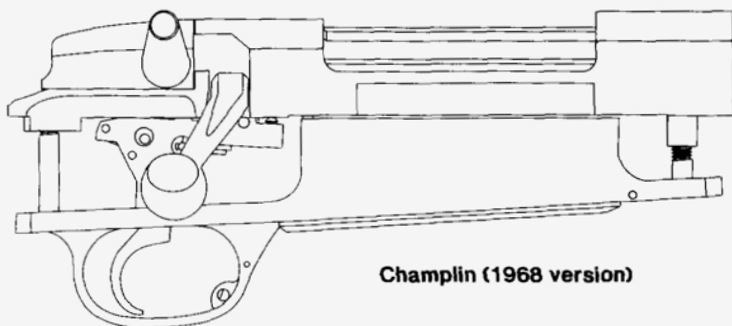


The story of the Champlin rifle goes back to 1966, when two young men, Doug Champlin and Jerry Haskins, joined forces to produce top quality custom rifles in north-central Oklahoma. Jerry Haskins, a onetime local football hero, had been drifting from job to job since dropping out of college in the mid 1950s. He settled into an old stucco gas station in Enid in 1962, trying his hand at several things, including horse trailers and customized jeeps. Called the "Great Plains Trading Post," this operation also included a small dry goods store and gun shop.

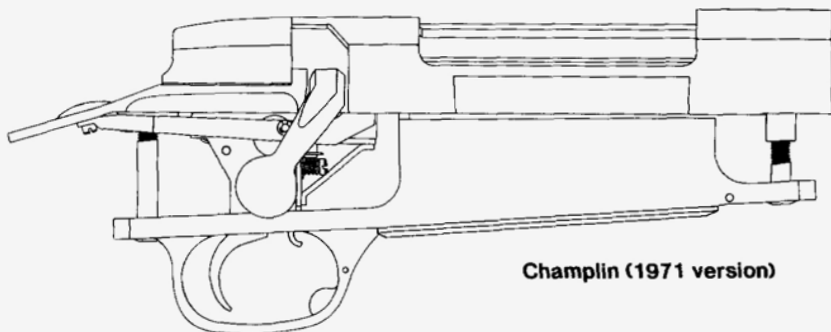
Haskins soon added custom Mauser rifles to his list of activities, building them under the "Thunder Bird Arms" banner. By early 1966, he felt he had finally discovered his true niche in life and wanted to concentrate his future energies entirely on rifles. To expand Thunder Bird Arms, he turned to Buddy Champlin, a friend who had helped out in several previous ventures. This time, however, he was introduced to Doug Champlin, the younger Champlin brother freshly returned from an army hitch in Germany. Not only was Doug Champlin as yet unencumbered by any business entanglements, but he had always had a particularly keen interest in firearms.

In contrast to Haskins, who had scratched for a living all his life, Doug Champlin was an heir to the Champlin oil fortune. Thus, on paper at least, it looked like the makings of an ideal partnership, bringing together Haskins' custom gun skills with Champlin's money. They incorporated in August 1966 as "Champlin-Haskins, Inc.," Haskins receiving one-third ownership and the title of Vice President and General Manager. Champlin assumed the Presidency of the corporation and a two-thirds controlling interest.

While they initially planned in terms of simply enlarging the Thunder Bird Arms operation, building rifles on FN Mauser actions, things changed before very long. Doug Champlin's back-



Champlin (1968 version)



Champlin (1971 version)

ground and innate sense of good taste didn't allow him to be content with the "Thunder Bird" logo, and it was dropped in favor of the more understated "Champlin & Haskins Custom Rifles."

The Mauser idea died also. After visiting Winslow Arms in Florida to learn more about their newly-chosen business, they began worrying about the commercial availability of top-quality actions over the long term. Also, others were using the FN action. Jerry Haskins in particular had a strong underlying need to offer something more unique and distinctive in a custom rifle than would be possible using a journeyman action. Thus, they arrived at the rather momentous, and perhaps even naive, decision to design and manufacture an action of their own. Drastically altering the scope of their plans, this put them into an arena where very few small operations had ever survived for long.

A trip to Chicago became necessary to buy machine tools for Enid. They ended up with a few machines, including a Bridgeport mill and fourteen-inch lathe, yet obviously nothing of the type necessary to set up for true manufacture. As the gas station in Enid was nevertheless being revamped for rifle building, Clayton Nelson, a gunsmith and stockmaker from Larned, Kansas, joined the company as production manager.

N.C. Jackson, head of Wichita Engineering & Supply, Inc., was

Champlin

hired to come down to look things over for a couple of days and to render some practical advice on their progress. It didn't take him long to recommend that they forget about making actions at Enid. While they naturally weren't about to heed such advice at the time, it ultimately proved prophetic. Of a total of twenty actions attempted at Enid, only three were ever completed, none of which were of marketable quality.

But equally troublesome at the beginning was the progress of the design itself. Jerry Haskins was an inventor and tinkerer. He kept Clayton Nelson occupied for over a year with changes to the action. By early 1968, Doug Champlin began wondering if a final "production" version would ever be ready, fearing that the operation would instead degenerate into little more than an endless series of prototypes, each one slightly different from the last. Thus, in order to get on with the business of building rifles, Champlin bought Jerry Haskins out of the corporation in May 1968, replacing him as General Manager with George Caswell. Later, in January 1969, "Champlin-Haskins" was reincorporated as simply "Champlin Firearms."

During the same time span, plans to make actions at Enid were also scuttled, and their manufacture was subcontracted out to Crescent Precision Products of Tulsa, Oklahoma. Crescent used tape-controlled tools to cut the bolt and receiver from solid steel billets. Other parts, like bolt handles, bolt sleeves, and trigger guards, were machined from investment castings poured by Hitchiner Manufacturing Co., Inc., in New Hampshire. Two hundred sets of parts were machined by Crescent, including one hundred right-hand and one hundred left-hand receivers, and delivered to Enid for fitting and assembly. While waiting for these parts, a couple dozen rifles were built on McGowen barreled actions, mainly as a tune up exercise for the newly hired employees at Enid.

By early 1970, Champlin needed more right-hand receivers, but Crescent had meanwhile been swallowed up by a larger company which held little interest in the project, at least at prices which Champlin considered reasonable. Thus, they again turned to N.C. Jackson for help. Arrangements were made to add receivers to the list of parts cast by Hitchiner and then have everything shipped to Wichita. Champlin ordered three hundred sets of castings from Hitchiner in June 1970. Subsequently machined by Wichita and delivered to Champlin in 1971, these constitute the last action parts made to date.

In tooling up for this job, Wichita made a lot of detailed changes

Champlin

to the action, and there is a distinct 1971 version. There was also an overall increase in the precision of the action. Parts machined by Crescent had been randomly chosen and fit together. Since Champlin was set up to do very little really serious machine work at Enid, a lot of hand filing and polishing ensued, and the actions ended up perhaps a little overly "custom."

Wichita's parts were machined to more exacting tolerances, requiring much less work on Champlin's part during assembly. The bolt was ground to dimension. Since this eliminated most of the polishing, its corners ended up perfectly sharp and clean, rather than rounded over. Also, both the bolt and receiver were heat-treated before final machining, resulting in a more uniform fit between the two parts.

For a while Champlin attempted to boost sales volume by offering these new actions separately, rather than only as part of a very expensive finished rifle. The asking price ranged between \$237.50 and \$277.50, depending on caliber. While this was a lot of money for an action in the white, it was well below what the rifles were commanding. After about a hundred were sold they were taken off the market. Champlin was finding that many of the rifles being made up on these actions fell far short of their own standards, yet because of the engraving on the receivers, they were often regarded as genuine Champlin rifles. Subsequently, actions were supplied only to Holland and Holland of London, whose workmanship obviously posed no serious threat to Champlin's reputation.

Champlin Firearms moved from Enid in 1974, relocating in the Woodring Municipal Airport a few miles out of town. They share a hangar with Doug Champlin's other enterprise, the "Great Lakes Aircraft Company." George Caswell has reorganized the



Original Enid location. The "Trading Post" is here shown boasting both the "Champlin & Haskins" and "Thunder Bird Arms" logos.

Champlin



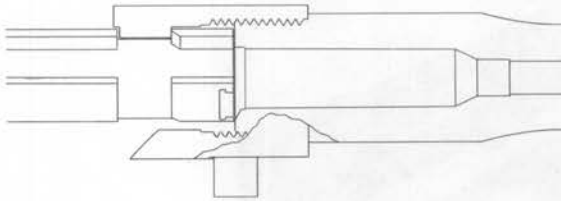
"Champlin Firearms," now located at the Woodring Municipal Airport, shares a small hangar with the "Great Lakes Aircraft Company."

operation, so that most income now comes from trading firearms, as well as marketing several lines of high-quality foreign arms. While he concedes that Champlin's reputation and success in the arms field was built on their own highly unique bolt action, Caswell also recognizes the difficulty of sustaining an operation solely on the basis of making and marketing a small volume of such rifles. Thus, he essentially gave up trying to compete with the Weatherbys and Colt Sauers. All advertising was discontinued, and prices were raised to the point where the rifles can appeal to only a very select market. Price of the basic rifle, which started out in the \$500 to \$600 neighborhood, exceeded \$3,000 by 1977.

When the partnership with Champlin was formed, Jerry Haskins recognized the rare opportunity it presented to put his personal imprint on a bolt action rifle, and he wasn't reticent to the task. His bolt had triple lugs on each end. The receiver even bedded uniquely into the stock, with front and rear recoil surfaces. The exterior of the action was octagonal, as were many of the barrels fitted to it. While ostensibly a "production" action, it was in fact largely hand-fitted, individually built to each customer's specifications. In the later versions, the bolt and receiver were cut with carbide tooling after hardening, resulting in some of the most dimensionally accurate components ever used in a hunting rifle. In perhaps Haskins' only serious design oversight, cartridges fed too low from the magazine, making it necessary to mill a small funnel into the barrel to pick them up. The bolt guides on its unique double-set locking lugs, restrained against twisting by a plunger at the rear of the receiver, and contains inside a firing pin controlled by a precision Canjar single-stage trigger.

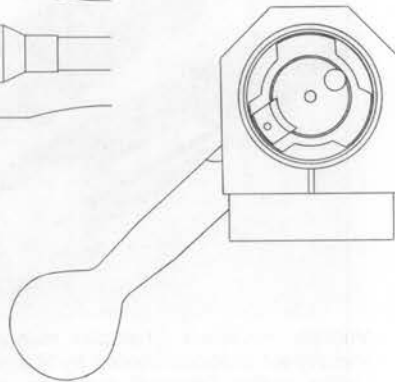
The breech is a simple flat-patterned type. Barrels are faced off square at the rear, then fit relatively close (about .015 inch breech

Champlin



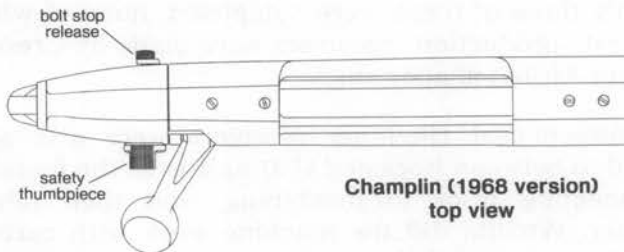
Champlin breech

Champlin (1971 version)
front view

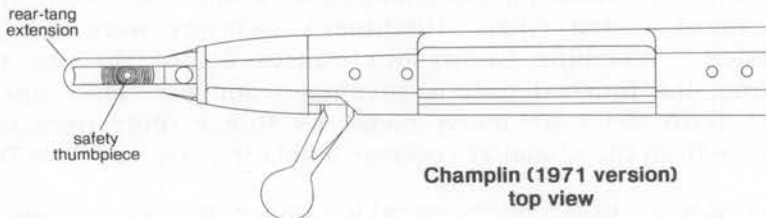


gap in the sample rifles examined) to the bolt. The small feed ramp milled into the rear of the barrel of course allows a little extra exposure around the lower circumference of the cartridge head.

The receiver ring has no gas ports to weaken it structurally. Inside, three channels are formed by long guide ribs on the bolt, the upper two leading directly to the ejection port, and the lower channel lying above the magazine. Gas entering the firing pin hole is also directed to the magazine, by way of ports in the bolt body. Any escaping gas that does reach the rear of the action, plus any tendency for the firing pin to blow rearward, is blocked by the solid rear wall of the bolt sleeve.

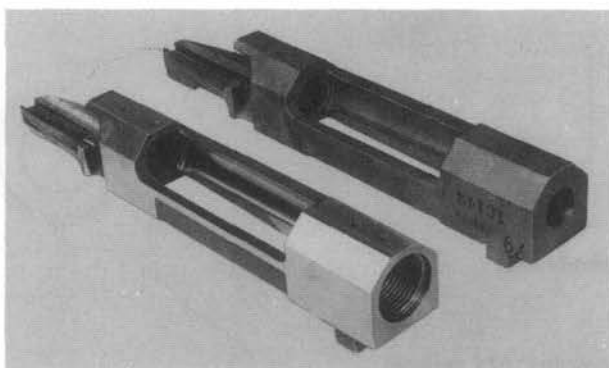


Champlin (1968 version)
top view



Champlin (1971 version)
top view

Champlin



Wichita machined Champlin receivers from heat treated investment castings poured by Hitchiner in New Hampshire. Unlike earlier Crescent receivers, these were made in a right-hand version only.

The receiver was cut on a patented octagonal pattern (U.S. Design Patent Des. 214,441 issued June 17, 1969 (J.D. Haskins)) which became more or less a trademark of the rifle. This motif was carried through also to the bolt sleeve and the floorplate assembly. Many Champlin barrels even had matching contours. Starting out in one size, the magnum version receivers were milled out underneath for an enlarged magazine opening, while a handful of "short" Champlin actions were made by cutting and welding. There is also a "single loading" model, the "Champlin 200," with the stock inletted to protrude up through the magazine opening as a wooden loading platform.

Prior to 1971, all receivers were cut from solid steel blanks. The first batch, attempted at Enid, were made from free-machining leaded steel. Only three of these were completed, none of which were sold. The first "production" receivers were made by Crescent, using high-strength AISI-4140 alloy steel.

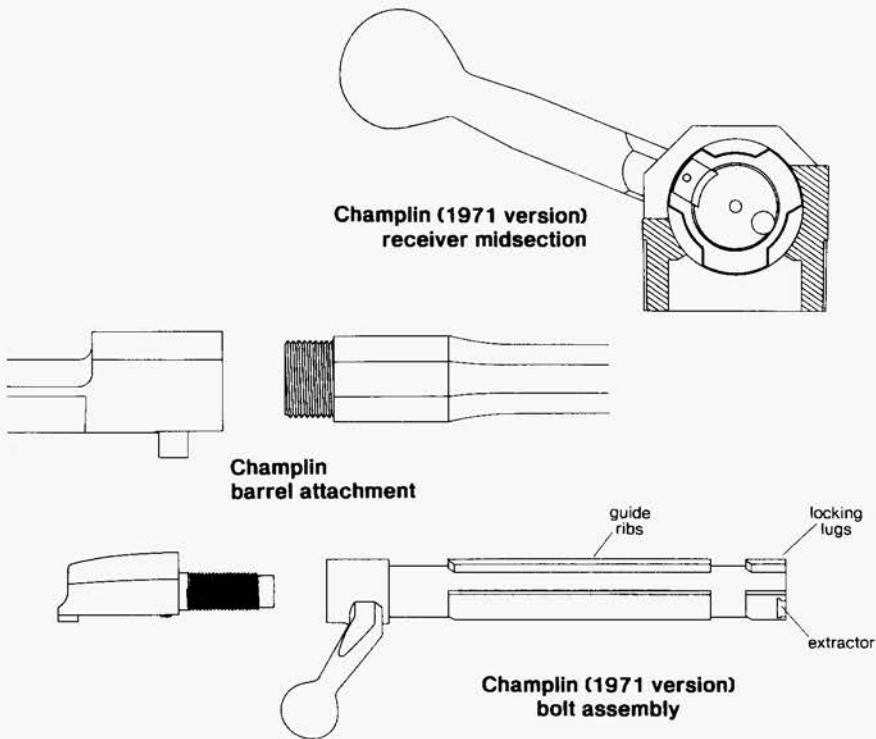
The later investment-cast Hitchiner receivers were also 4140 alloy, heat treated to between Rockwell C 37 and 41 at the foundry. Rather than annealing prior to machining, and then reheat treating them later, Wichita did the machine work with carbide cutters. They consequently ended up as straight and concentric as the finest match rifle. Hitchiner's castings were not highly detailed. Weighing twenty-four ounces before Wichita started cutting, the finished part is seventeen ounces. This represents more than twice as much metal as Ruger finds necessary to remove from the Model 77 receiver billets they cast at Pine Tree.

Recoil is not taken by the usual lug under the receiver ring alone. Rounded cavities or "lungs" recessed into each side of the rear

Champlin

tang are also painstakingly inletted into the stock. These, together with the rear guard screw block, supplement the front recoil lug, providing what Champlin considers to be more than adequate recoil surface for any hunting cartridge.

Initially two rear tang styles were offered, a standard version extending only about one-half inch beyond the rear guard screw, and a long welded-on steel strap suggested by Elmer Keith. In 1971 Champlin compromised on a single medium-tang style, but unfortunately not before the casting dies were made up. Thus, a short piece was welded to the rear of all the Wichita-machined receivers, extending the tang about 1-1/4 inches. This not only provided most of the style and flair of the expensive "Keith" backstrap, it also formed a platform for the safety thumbpiece. For those customers still wanting the bolt sleeve safety, this tang extension is simply sawed off again.



The Champlin bolt is an interesting blend of a conventional protruding-lug design, and a Weatherby-like "full-diameter" type. Its patented configuration (U.S. Patent 3,494,216 issued February 10, 1970 (Jerry D. Haskins)) has three massive front locking lugs cut on symmetrical one hundred and twenty degree centers.

Champlin

Aligned behind each of these is a long rib with the same cross sectional shape. The original concept called upon these ribs to seat in the receiver, giving a total of six locking lugs. While Jerry Haskins' prototypes were built this way, achieving uniform contact on separate sets of locking surfaces located in the receiver ring and bridge proved impractical, even on a semi-custom production basis. Rifles sold had at least .002 to .003 inch clearance at the bridge, thus leaving the ribs to act only as "safety" lugs.

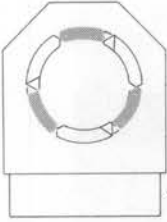
Even if they are no longer real locking lugs, the ribs do form a novel guide system for the bolt. The dual locking seats in the receiver form short front and rear raceway channels. In between, the receiver is bored out oversize. Thus, once the bolt moves back a short distance, the raceways in the bridge do the guiding. The arrangement works quite well, although perhaps not quite like a Krag or Mannlicher-Schoenauer, as some reviewers have concluded.

Jerry Haskins made the locking lug arrangement perfectly symmetrical. It was slightly altered in 1971 by increasing bolt rotation from sixty to sixty-four degrees. The extra few degrees serve to help center the seating surfaces on each other during lockup, thus providing greater actual bearing contact. In both, the camming system functions very well for a reduced-lift action. Opening effort is not excessive, while the cams cut on each locking lug and guide rib render enough displacement to close on a cartridge without serious hesitation.

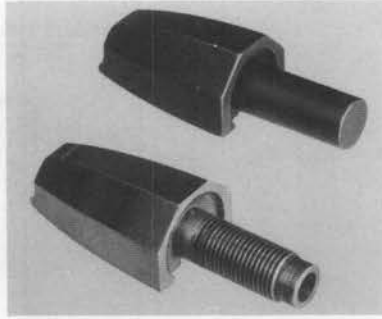
Wichita rough machined the bolt bodies from AISI-4140 barstock, then ground each to final dimension after heat treatment. As with the receiver, this sequence yielded a part which is so straight and true that it can work smoothly with relatively little clearance or play. The bolt handle and the rear bolt hub are investment cast as a single part, which is pressed and locktited to the bolt body. Since the two parts are heat treated individually before assembly, they can each be given the optimum hardness needed for their job. The bolt body is hardened to about Rockwell C 45, roughly the same as the earlier Crescent bolts, while the handle, with its hard-working extraction cam, is heat treated approximately ten points higher.

A heavy shroud-type bolt sleeve caps the rear of the bolt. Its octagonal exterior not only blends perfectly with the lines of the receiver, but it fits up against the bridge so closely as to almost resemble a continuous piece. Wichita uses precise thread qualification which leaves only about a .005 inch gap. Once the bolt and bolt sleeve are fitted together, they are matched permanently with a receiver, and the entire outside contour of the action is carefully blended on a belt sander.

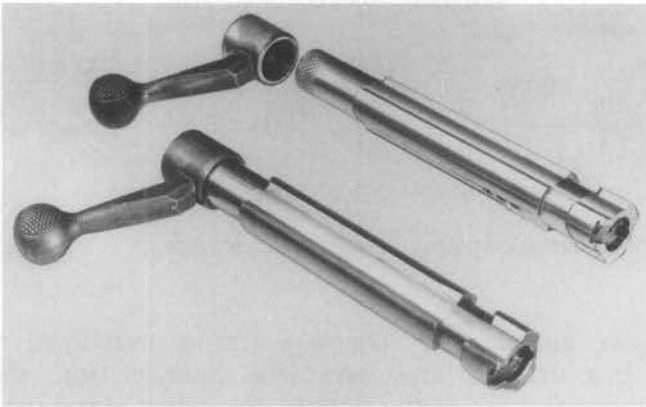
Champlin



**Champlin
(1971 version)
locking pattern**



While starting as investment castings, bolt sleeves nevertheless required considerable machine work to reach finished form. Those made prior to 1971 had slightly longer shrouds and larger-diameter threads.



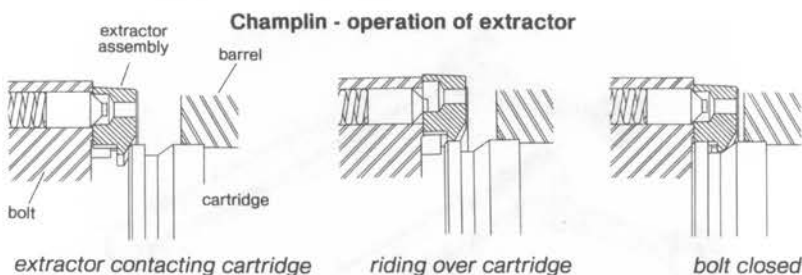
Finished bolt bodies are pressed and glued into investment-cast handles. Pre-1971 handles lacked integral hubs, and were simply welded in place. Completed bolt assemblies are lapped at Enid with the aid of a special spring fixture threaded into the receiver ring to apply concentric pressure on the face of the bolt.

The first prototype rifle made at Enid had a special "compound" extractor, with dual opposed claws to grip the cartridge rim concentrically during primary extraction. Upon bolt withdrawal, the left claw disengaged to allow normal ejection. How practical such a complex arrangement might have proven in a hunting rifle was never established, but Haskins' insistence on spending time and money perfecting it certainly helped lead to the split with Champlin. In order to get underway producing rifles, Doug Champlin, the more practical and cost-conscious partner, stepped in and made the decision to use the simple and proven Model 70 type of extractor arrangement. Its sliding flat plate is cast from beryllium copper, a high-strength nonferrous alloy, and gives a wide (.250 inch) grip on the cartridge rim.

Champlin



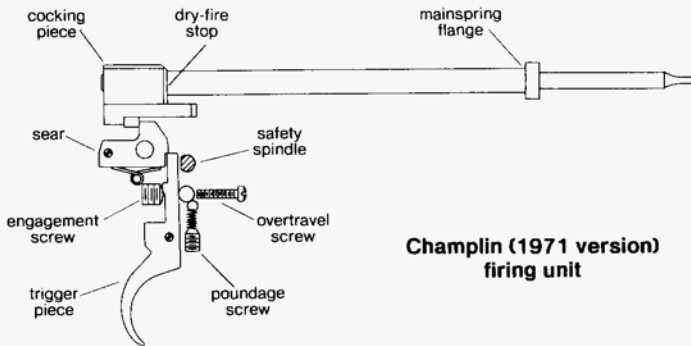
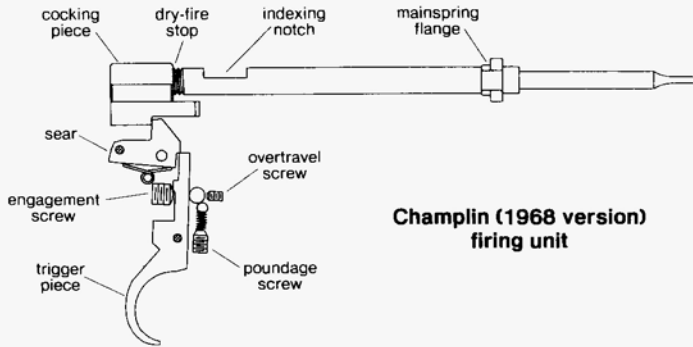
"Keith-Grade" rifles featured a long welded-on "backstrap" to go with "Dagoon" style trigger guard. Costing the customer only an extra \$40, this backstrap entailed a great deal of extra inletting, and was thus discontinued before too long.



The trigger guard and floorplate frame, machined with the magazine box from a large one-piece steel casting, shares the overall octagonal motif of the action. Besides a standard rounded trigger bow, Haskins fashioned an optional "Dagoon" version, with a concave back to protect the second finger from recoil. When Elmer Keith suggested combining this rather rakish trigger guard with a long welded-on bent-metal "backstrap" for which he had a predisposition, the so-called "Keith-Grade" rifle came into being. Shaped to follow the top of the stock, this strap accepted a long bolt threaded up from a special trapdoor grip cap to clamp the stock and help distribute recoil forces.

The integral magazine box lacks any special guide surfaces inside. Instead, feed lips are cut directly into the receiver, one of the few machine operations actually done by Champlin. The receivers are roughed out underneath at Wichita, then custom fit at Enid for each particular cartridge. As they feed forward, cartridges pass between the two lower locking seats. While this provides good lateral control, the feed path is too low, and the bullet approaches the chamber about an eighth inch below where it would in a conventional Mauser action.

Champlin

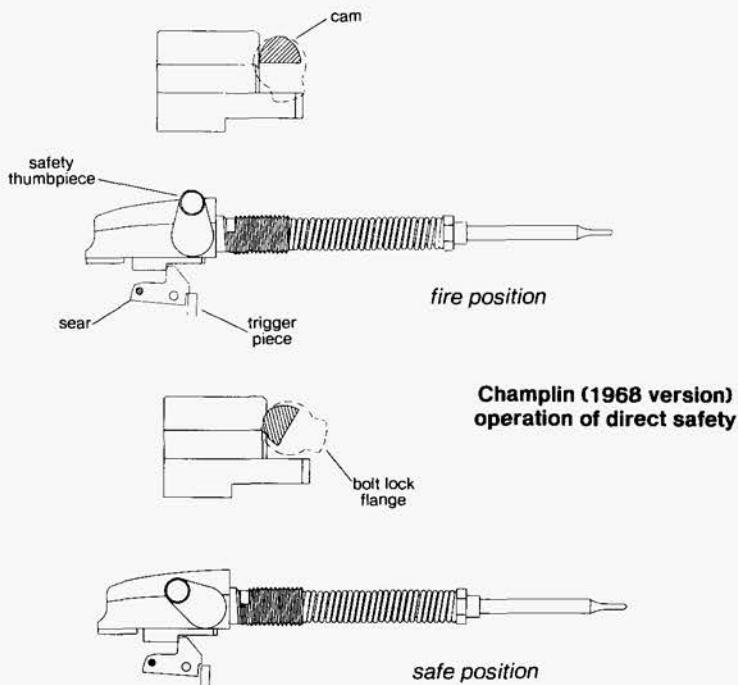


Haskins' firing pin had a swaged-on mainspring flange, plus a deep indexing notch cut near the back. A cleaner and more concentric one-piece design was substituted by Wichita in 1971. While smaller in diameter, it was unnotched, and thus actually stronger and more rigid than before. Instead of the index notch, the firing pin was locked against turning by a simple setscrew in the bottom flange of the cocking piece. A new mainspring was also substituted, allowing a smaller-diameter bolt interior. For this purpose, Champlin simply switched from the Mauser '98 "Blitz-schnell" speed-lock mainsprings they had been buying from the Wolff Spring Company, to the smaller-coiled Model-70 version of the same spring.

Champlin offers the choice of two safety locks, one journaled to the wall of the bolt sleeve and acting directly against the firing pin assembly, and a tang-mounted shotgun type operating through a linkage to block the trigger. While the direct version was originally "standard," it soon became evident that most customers preferred the tang-mounted option.

Thus, in 1971, the new triggers were designed to include a safety spindle, and extended tangs were welded on all receivers to serve

Champlin

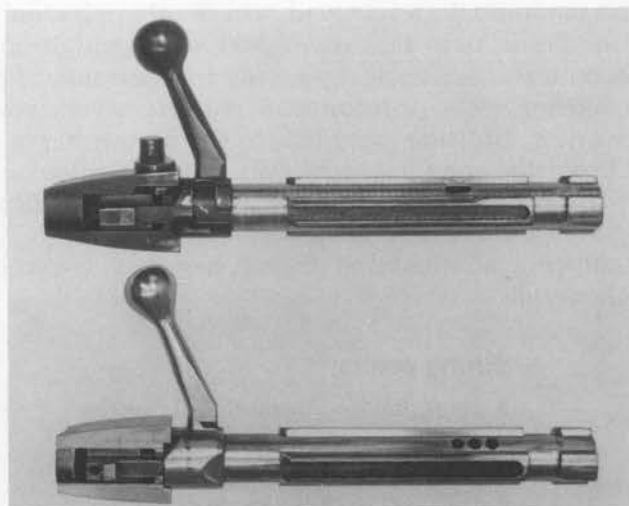


as a mounting platform for a sliding thumbpiece. Moving the thumbpiece rearward to *safe* rotates the spindle by way of a long sheet-metal linkage to block the trigger piece. Simultaneously, the head of this connecting link moves back into a slot to lock the bolt handle. Slid forward, the connecting lever disengages the bolt handle, while a clearance flat on the spindle rotates in front of the trigger piece.

Champlin originally used an off-the-shelf "Mauser" trigger made by Canjar. While it featured Canjar's usual excellent single-stage internal geometry, with full adjustments, its mounting underneath the Champlin receiver was somewhat jerry-built. Thus Canjar designed a new trigger housing specially to fit their 1971 action. Flat on top to fully seat against the milled underside of the receiver, it is held in place directly with a sturdy locating pin and conehead screw.

Besides the safety spindle, the new trigger houses the bolt stop, a 3/16 inch diameter hardened steel plunger projecting up through the receiver floor to engage a deep groove milled in the lower bolt rib. The plunger is lowered to clear the boltway by a triangular bracket fitted to the front of the trigger housing, and extending

Champlin



Bolts made by Cresent (top) and Wichita (bottom) had different guide grooves. Original L-shaped groove required more milling, but didn't cycle bolt stop plunger as the later "escape" ramp did. Gas ports also changed. Three drilled holes in Wichita bolt are less expensive, plus combine for greater vent area, than single oblong port Cresent milled out.

down into the trigger bow. Before 1971, this plunger was only one-quarter inch in diameter, and was released by a separate lever on the left side of the rear tang, just above the stock line.

Summary

The Champlin is clearly one of the best looking bolt actions ever built. It obviously also has some of the strongest locking lugs.

Being primarily a big-game rifle, weight is pretty high. Its fifty ounces places it in the same category as the Weatherby Mark V, and about one-half pound above actions like the Remington Model 700, Winchester Model 70 and Ruger 77. The Champlin rifle is first and foremost a custom rifle, however. Upon request, Champlin can reduce action weight by roughly this amount by careful milling cuts on non-strength portions of the receiver and trigger guard.

The "fame" of the Champlin rifle far outstripped its actual numbers. While it has gotten a lot of attention in gun periodicals, there really aren't that many around. They originally planned in terms of 300 to 400 rifles a year, which would now account for around 4,000 or 5,000 in circulation. In fact, there are barely one-tenth that number existent.

Champlin

Yet, the company has survived, where others haven't. Champlin's oil fortune could help tide them over some rough spots, but they have become self sufficient by giving up thoughts of competing on a mass market basis. Instead they cater to a very select and high-priced market. Shifting emphasis to the marketing of other quality lines of firearms, and using the few Champlin rifles built mainly for building a reputation, has also contributed to this success.

The following summarizes the strong and weak points of the Champlin action:

Strong points:

1. Handsome, streamlined design.
2. Fully adjustable override trigger.
3. Strong locking system.
4. Shrouded bolt sleeve.
5. Smooth bolt operation.
6. 8 x 40 scope-mounting system.

Weak points:

1. Lack of override bevel on bolt stop.

Champlin (1968 version) Dimensions

OPERATING

Extraction: set-back — .12 in.

leverage — 5 to 1

Chambering: cam-forward — .13 in.

leverage — 6 to 1

Bolt rotation — 60°

Bolt travel — 4.57 in.

Cock-on-opening; .239 in.
mainspring compression
proportioned as follows:

opening — .153 in.

closing — .086 in.

IGNITION

Firing pin travel: at impact — .179 in.
dry-fired — .239 in.

Lock time — 2.8 ms.

Impact velocity — 12.4 ft./sec.
energy — 75.7 in.-oz.
impulse — 1.02 oz.-sec.

Striker/firing-pin hole diameters — .069 in./0.077 in.

RECEIVER

Overall length — 8.99 in.

Length of loading/ejection port — 3.38 in.

Ring cross-section: width — 1.274 in.
height — 1.275 in.

Barrel threads — 1-14

Recoil-lug bearing area — .42 sq. in.

Guard screws — 1/4 x 28 (Allen-head drive)

Scope mounting screws — 8x40

BOLT

Lug shear area — .627 sq. in.

Lug bearing area — .069 sq. in.

Bolt diameter — .870 in.

Lug undercut diameter — .676 in.

Lug diameter — .870 in.

Bolt-face counterbore — .128 in.

MAGAZINE

Length — 3.68 in.

Depth: front — 1.85 in.
rear — 2.04 in.

Capacity: 7mm Remington Magnum (.532 in. head) — 3
.30-06 Springfield (.473 in. head) — 4

Champlin

WEIGHT

Receiver group 19.2 oz.
Bolt group 17.2 oz.
Magazine/floorplate group 11.8 oz.
Total action weight 48.2 oz.

Champlin (1971 version) Dimensions

OPERATING

Extraction: set-back — .06 in.
 leverage — 6 to 1
Chambering: cam-forward — .09 in.
 leverage — 6 to 1
Bolt rotation — 64°
Bolt travel — 4.61 in.
Cock-on-opening; .213 in.
 mainspring compression
 proportioned as follows:
 opening — .198 in.
 closing — .015 in.

IGNITION

Firing pin travel: at impact — .152 in.
 dry-fired — .213 in.
Lock time — 2.6 ms.
Impact velocity — 11.3 ft./sec.
 energy — 60.9 in.-oz.
 impulse — .901 oz.-sec.
Striker/firing-pin hole diameters — .070 in./0.078 in.

RECEIVER

Overall length — 10.22 in.
Length of loading/ejection port — 3.44 in.
Ring cross section: width — 1.260 in.
 height — 1.298 in.
Barrel threads — 1-14
Recoil-lug bearing area — .38 sq. in.
Guard screws — 1/4 x 28 (Allen-head drive)
Scope mounting screws — 8 x 40

BOLT

Lug shear area — .636 sq. in.

Lug bearing area — .076 sq. in.

Bolt diameter — .871 in.

Lug undercut diameter — .681 in.

Lug diameter — .871 in.

Bolt-face counterbore — .119 in.

MAGAZINE

Length — 3.66 in.

Depth: front — 1.92 in.

rear — 2.22 in.

Capacity: .30-06 Springfield — 4

7mm Remington Magnum — 3

WEIGHT

Receiver group 20.0 oz.

Bolt group 17.2 oz.

Magazine/floorplate group 13.6 oz.

Total action weight 50.8 oz.



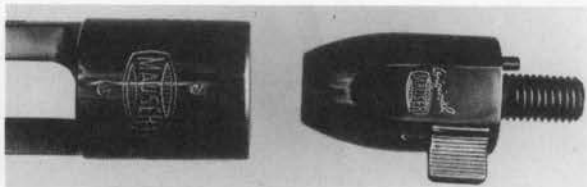
Mauser Model 3000



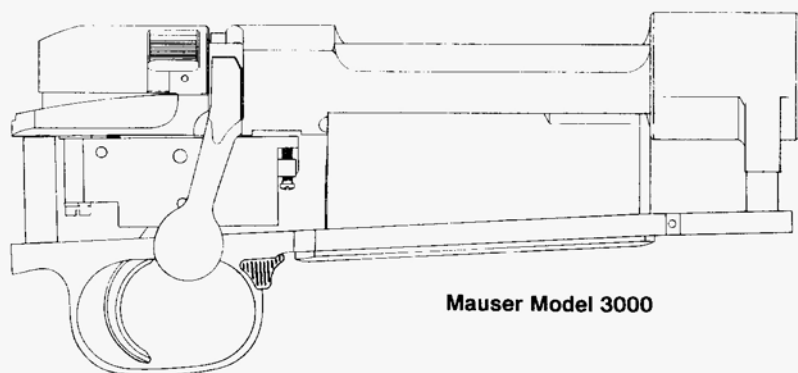
The Model 3000 was built by the Friedrich Wilhelm Heym Arms Factory of Muennerstadt, West Germany, and marketed by Mauser-Jagdwaffen GmbH of Oberndorf. It was imported into the U.S. first by Interarms Ltd, starting in 1969, and then a couple of years later by the Mauser-Bauer Corporation until importation was discontinued in 1974. Before these "Mausers" appeared, Montgomery Ward marketed basically the same rifle in the U.S. as the Western Field 770. Heym also sold it for many years directly in Europe as the Heym SR 10. A later, slightly modified variation, the SR 20, is in fact still made and sold in Europe by Heym.

Mauser had three designations for its version of the rifle; the Model 2000, Model 3000, and Model 4000. The first two used the same action, while the Model 4000 had a shortened receiver intended for .222 Remington size cartridges. The Mauser organization took great pains to sell these rifles as "original" Mausers, marking each receiver on the side with the Mauser name, and impressing the Mauser banner into the top of the receiver ring and bolt sleeve.

In fact, however, there was no direct "Mauser" bloodline. Not only were these rifle actions designed and made elsewhere, the engineers at Oberndorf never even had an opportunity to contribute to their basic specifications. The action was laid out by the late Rolf Heym in 1964, five years before Mauser assumed temporary financial control of the Heym factory (1969-72). Still, Heym's action does have



Despite logo impressed on top of receiver ring and bolt sleeve, the Model 3000 was designed and manufactured about 150 miles from Oberndorf, at the Heym works in Muennerstadt, very close to the East German border.

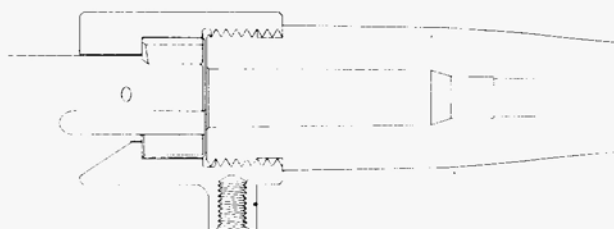


Mauser Model 3000

some external features which bear enough resemblance to the classic Mauser 98 as to almost suggest a direct lineage. At the front, the receiver ring is enlarged in diameter, while at the back the rear tang is left narrow like the Mauser by cuts on each side. Even the barrel threads match those of the Mauser 98.

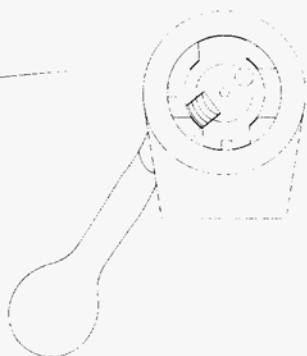
Modern fabrication methods of course replaced the complex forgings of the classic rifle. Both the recoil lug and the bolt handle is welded into place. Smooth movement of the bolt is ensured more by a special keyway system than close-toleranced and honed parts, while a simple vertical rod positioned on the left side of the receiver stops its rearward travel. Inside the bolt is a multi-piece firing pin, controlled by an override trigger and a two-position safety pivoted in the bolt sleeve.

The Model 3000 does not have "inner collar" breeching, a standard now for over eighty years in true Model-98 type rifles. Instead it breeches up more like the post-'64 Winchester Model 70. The locking



**Mauser Model 3000
breech**

**Mauser Model 3000
front view**



Mauser Model 3000

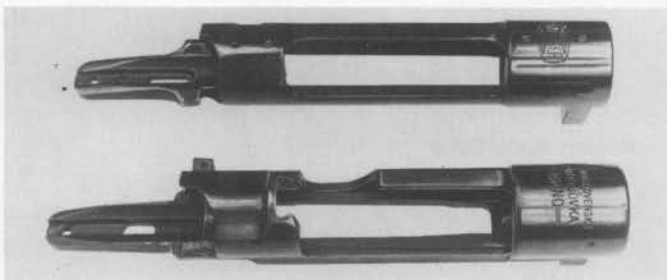
lugs are up flush with the bolt-nose rim, while the rear of the barrel is also faced off square. A bolt face which is recessed only 0.109 inch behind the locking lugs allows seating the cartridge case deeply and securely inside the barrel.

The firing pin is jointed at the mainspring flange like the M1903 Springfield. This leaves the possibility of escaping pressure blowing its rear section back out the unshrouded bolt sleeve. To prevent a pressure buildup, a large (5-mm diameter) port is drilled in the bolt walls just forward of the mainspring. Gas released into the left raceway by this port is blocked at the rear of the receiver by a flange on the front of the bolt sleeve, deflecting it away from the shooter's face in the event of a primer failure or case separation.

The receiver is machined from steel barstock. While it is dimensioned on its exterior much like the classic Model 98, inside it doesn't need the same extra-deep right raceway which is cut to accommodate Mauser's big offset extractor. As a result, in the Model 3000 the large diameter receiver ring renders unusually thick walls around

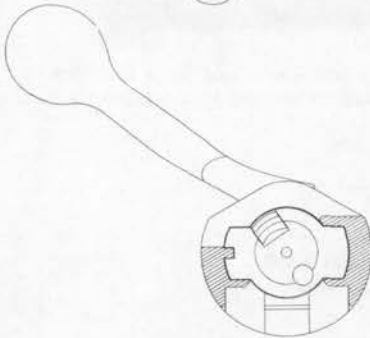
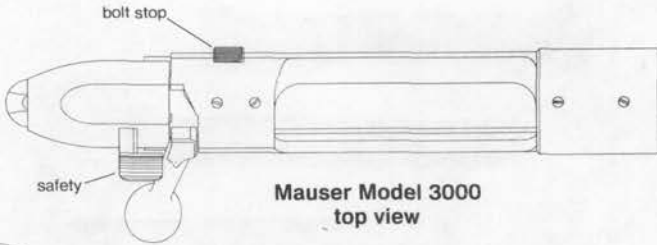


Model 3000 receivers started out from simple lengths of barstock, rather than from forgings as the classic Model 98 receivers did.



Finished Mauser Model 3000 receiver (back) bears some overall resemblance to the classic Mauser 98 (front).

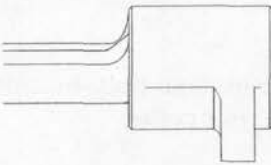
Mauser Model 3000



**Mauser Model 3000
receiver midsection**



Recoil lug is a separate piece of thick steel plate. Weld fillet can be seen on close inspection of juncture with the outer diameter of the receiver ring.



**Mauser Model 3000
barrel attachment**

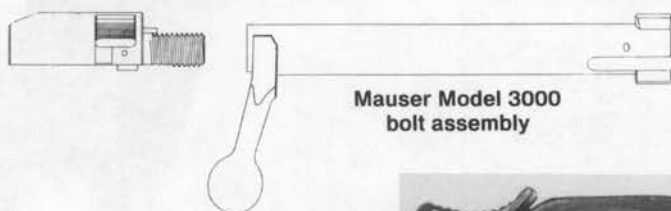
the breech. Minimum wall thickness in the region of the locking lugs is 0.205 inch, almost a sixteenth-inch greater than in the Model 98 pattern. Further forward, around the barrel, wall thickness is the same as the Mauser 98. The barrel threads exactly match the Model 98, not only in diameter and pitch, but in the lengthwise measurements as well. This is a phenomenon common also to the Voere rifles. Model 98 rifles were made in such enormous numbers that some of the tooling associated with their production still represents a standard in Germany to this day.

The bolt is of very simple design. It starts as an oversize steel bar, which is turned down through the middle to leave collars at the front and rear. Dual-opposed locking lugs are milled out of the metal left

Mauser Model 3000

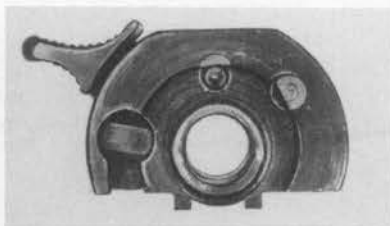


Like the receiver, the Model 3000 bolt starts out as a barstock blank. Enlarged section at rear ends up serving as the base for a welded-on bolt handle.



**Mauser Model 3000
bolt assembly**

Clockwise from left, front face of bolt sleeve is drilled for safety spindle, bolt detent plunger, and bolt-sleeve lock plunger.



in the front collar, while an investment-cast bolt handle is arc-welded onto a flat base formed from the rear collar.

The bolt handle used in the original Heym rifles (SR 10 and Montgomery Ward Model 770) looked something like that on a Remington Model 700, with a checkered oval-shaped grasping knob. In the first lots of rifles shipped as "Mausers," these knobs were simply cut off and pear-shaped versions welded on in their place. In later rifles, the Mauser-style handles were installed directly at Heym.

A massive sleeve cut from solid steel barstock is threaded to the rear of the bolt. Despite containing almost a quarter pound of metal, it does not have a shrouded back wall, and thus does little more than guide the rear shaft of the firing pin and house the safety. A small spring plunger in its front rim cooperates with a matching round-bottomed notch in the rear lip of the bolt to form an index system between the two parts similar to that in the Model 98. As the bolt is opened and drawn back away from the receiver, this plunger springs forward into its notch to lock the bolt sleeve from turning.

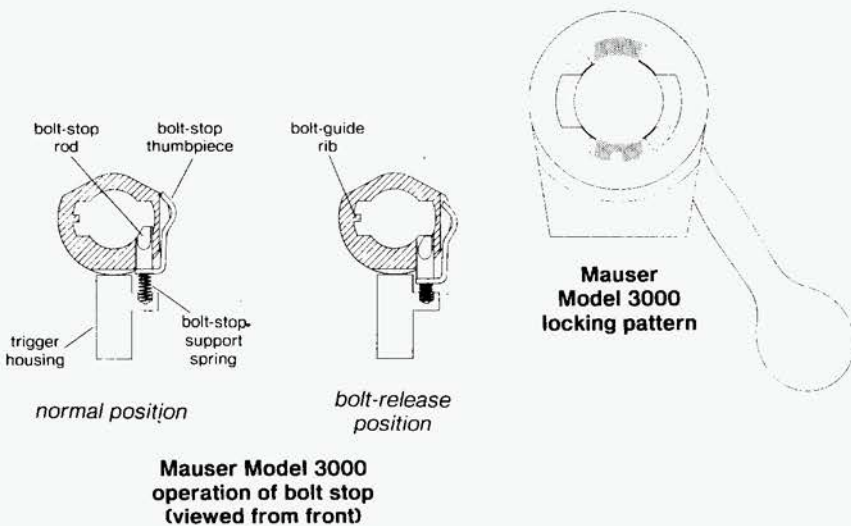
Mauser Model 3000

On the closing stroke, the locking plunger is forced back by contact with the bridge, freeing the bolt to rotate down into firing position.

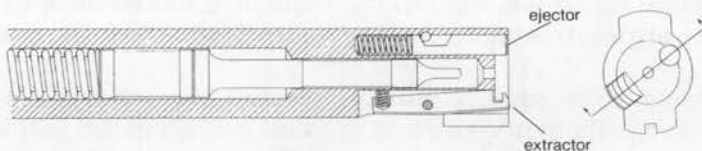
A second, even smaller plunger swaged into the front rim of the bolt sleeve rests in a V-notch in the bolt rim when the bolt is closed. There is no positive bolt lock associated with the safety mechanism of the Model 3000, and thus this spring-powered detent acts as the only means to prevent misfires in the field from a partially raised bolt handle.

Diametrically opposed locking lugs are cut at the very front of the bolt head. A groove milled lengthwise into the outer circumference of the right lug lines up with a special rib broached into the middle of the receiver raceway to form a special guide. Similar to those used in several bolt actions of recent years, this keyway system controls angular play closely along the entire path traveled by the bolt, allowing the action to function very smoothly without binding.

A simple steel rod, projecting into the left lug raceway by way of a hole drilled through the underside of the receiver bridge, acts as the bolt stop. The lower end of this rod is swaged to a sheet-metal thumbpiece which slides on the outside of the receiver, in a clearance slot milled down the left wall of the bridge. The assembly is supported in the raised position by a small coil spring seated on a flange projecting from the side of the trigger housing. The upper face of the rod is ground on its front for good contact with the left locking lug, and on the back side at an angle which permits easy bolt insertion.

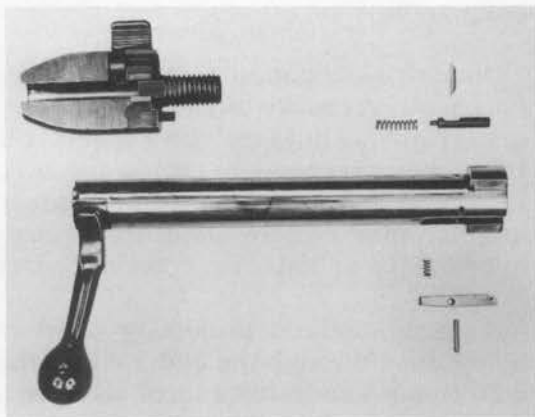


Mauser Model 3000



Mauser
Model 3000
bolt-head details

Massive barstock bolt sleeve constitutes a large percentage of the overall weight of the bolt assembly. Pear-shaped bolt handle knob was specified by Oberndorf to increase the action's "Mauser" flavor.



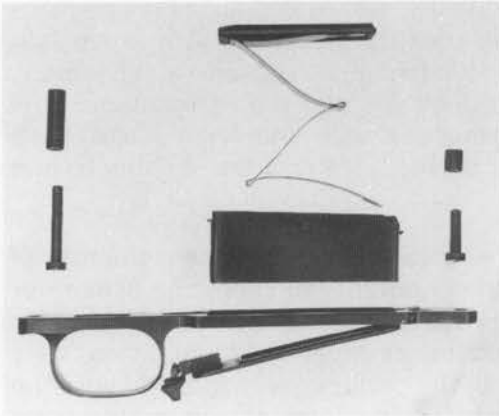
The extractor is a bar-like part, investment cast from alloy steel. Pivoted on a crosspin and urged inward by a small coil spring, its claw grips the case rim over a sixty-degree circumference. On the opposite side of the bolt face is a spring-loaded pin to eject spent cartridge cases as the bolt is drawn back under the loading port of the receiver.

The magazine is a double-column type, with a box folded from sheet metal and spot welded at the rear into a solid one-piece unit. Guide lips are pressed directly into the top of the box, while tabs at both the front and back lock it into proper alignment under the receiver.

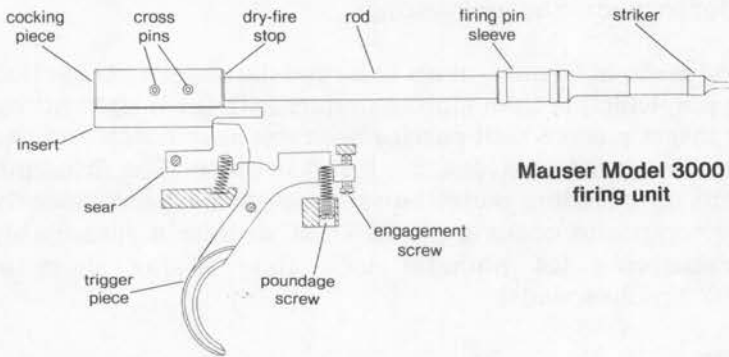
Within the magazine is an investment-cast follower piece, supported underneath by a W-shaped ribbon spring mortised to the floorplate. This floorplate, die cast from aluminum, is pivoted at the front to a one-piece aluminum trigger guard. Its catch on the other end consists of an awkward serrated aluminum casting which straddles the front flange of the trigger guard. To release the floorplate, the catch must be simultaneously pulled forward and down, inconvenient even after some familiarity is acquired in the procedure.

The Model 3000 firing pin assembly is constructed basically like

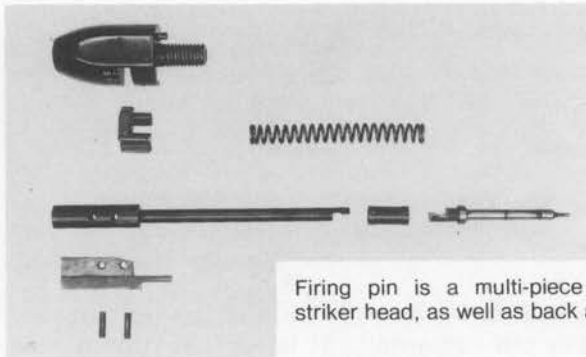
Mauser Model 3000



Magazine assembly is simple and conventional in design, except for a rather novel, but also very awkward, floorplate release.

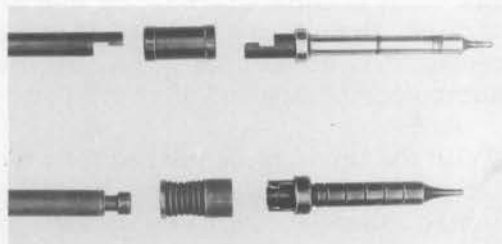


**Mauser Model 3000
firing unit**



Firing pin is a multi-piece construction at the striker head, as well as back at the cocking piece.

Mauser Model 3000 (top) has similar jointed firing pin head to Springfield M1903 (bottom), although a better fit reduces cushioning on impact with the primer compared to the Springfield.

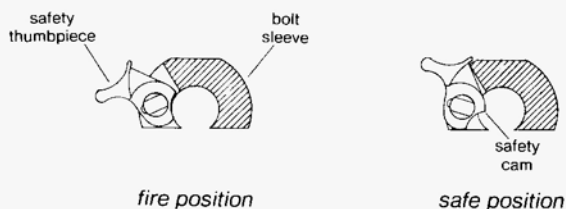


Mauser Model 3000

that of the old M1903 Springfield rifle, where instead of a one-piece firing pin shaft and detachable cocking piece, the striker tip is a separate part, attached to the main firing pin rod with a lap joint. A sleeve slides on from behind to lock the two pieces together. This joint fits closer than in the Springfield, with only about a 0.001-inch take-up, and thus cushioning of the striker blow is much less pronounced.

The U.S. Army used this type of construction back near the turn of the century in the belief that the capability of replacing broken or damaged striker tips would improve battlefield logistics. Heym also felt it could save time and money in repairs. In addition, they wanted to make the main body of the cocking piece integral with the firing pin shaft, and thus needed some form of removable front flange in order to mount the mainspring.

The cocking piece is formed on an enlarged-diameter rear section of the firing pin, which is then slotted underneath for a tight-fitting rectangular insert piece which carries both the sear notch and the cocking cam. Two cross-pins lock this insert in place. The firing pin assembly ends up weighing more than three ounces, thanks largely to this hefty composite cocking piece. Thus, despite a reasonably powerful mainspring (24 pounds), lock time is far short of spectacular (3.7 milliseconds).

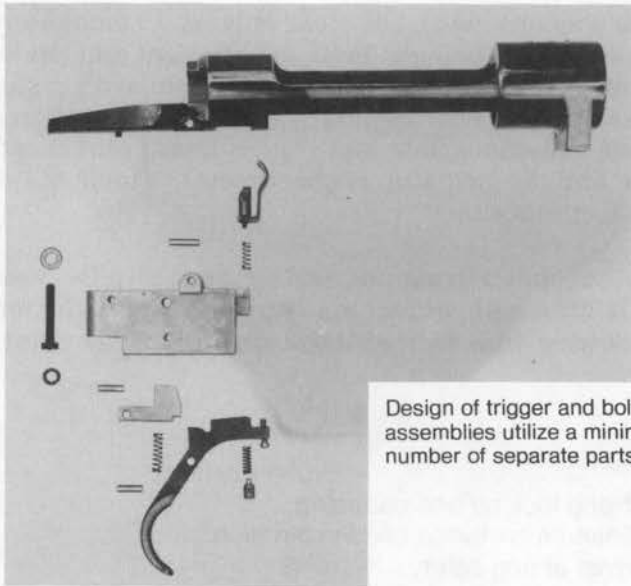


**Mauser Model 3000
operation of safety**

A two-position safety, pivoting in the right side of the bolt sleeve, directly engages the firing pin assembly. It is an investment-cast part, with a camming hub on one side of its pivot point and a serrated thumbpiece formed further away on the other for mechanical advantage. A spring-loaded ball detents the thumbpiece at each end of a forty-five degree operating arc.

With the thumbpiece pushed fully down, a clearance notch in the hub of the safety allows free passage of the firing pin. Snapped upward to *safe*, the cam engages the front rim of the cocking piece, forcing the firing pin back about 0.015 inch. There is no bolt lock

Mauser Model 3000



Design of trigger and bolt stop assemblies utilize a minimum number of separate parts.

associated with this function, and the rifle can thus be operated to load or unload shells with the safety engaged. This is a good arrangement, particularly since the problem of misfires from a partially lifted bolt handle is alleviated by the separate spring-plunger detent mechanism described earlier.

An aluminum die-cast trigger housing is secured under the receiver by means of a crosspin and a long vertical machine screw. Pivoted inside this housing is a lever-type sear and a trigger piece. The trigger piece, which blocks the sear from underneath, is pivoted near its center of mass to give it a minimal sensitivity to accidental jars or shocks. Its forward flange contains screws for poundage and sear engagement, both accessible beneath the floorplate. There is no adjustment for overtravel.

The receiver of the Model 3000 is stamped "Patangem" on the side, and the brochures for the rifle contained the statement "patents applied for." Heym did apply for a German patent on the design of the trigger and firing pin assembly, but was granted only an "Offenlegungsschrift," which simply acknowledges the disclosure of an invention to the German patent office, in anticipation of the possible issuance of a patent. Upon examination, the "novelties" of this disclosure failed to comply to German standards, and no patent (Deutsches Patentant) was actually issued.

Mauser Model 3000

Summary

The Model 3000 was originally imported only as a complete rifle. By 1973, actions alone were being offered, in both right and left-hand versions. It might be described as a yeoman action, with a sturdy and workmanlike design, but nothing that one could get really enthusiastic about. The floorplate and trigger guard unit is rather thick and coarse, and the bolt stop is sheet metal. The bolt sleeve isn't an aesthetic triumph either.

Yet, except for the jointed firing pin, and perhaps also the welded recoil lug, there is little with which one can find any fundamental objection. The following summarizes the strong and weak points of the action:

Strong points:

1. Strong locking and camming.
2. Minimum cartridge head protrusion.
3. Direct-acting safety.
4. Good bolt-guide system.
5. Bolt detent.
6. Accessible trigger adjustments.

Weak points:

1. Jointed firing pin.
2. Inconvenient floorplate catch.
3. Heavy and unshrouded bolt sleeve.
4. Lack of overtravel adjustment in trigger.
5. Sheet metal bolt stop thumbpiece.

Mauser Model 3000 Dimensions

OPERATING

Extraction: set-back — .10 in.
leverage — 10 to 1

Chambering: cam-forward — .15 in.
leverage — 9 to 1

Bolt rotation — 93°

Bolt travel — 4.56 in.

Cock-on-opening; .330 in.
mainspring compression
proportioned as follows:
opening — .255 in.
closing — .075 in.

IGNITION

Firing pin travel: at impact — .262 in.
dry-fired — .330 in.

Lock time — 3.7 ms.

Impact velocity — 12.8 ft./sec.
energy — 93.9 in.-oz.
impulse — 1.23 oz.-sec.

Striker/firing pin hole diameters — .076 in./0.078 in.

RECEIVER

Overall length — 8.71 in.

Length of loading/ejection port — 3.48 in.

Ring diameter — 1.410 in.

Barrel threads — 1.1 - 12

Recoil-lug bearing area — .50 sq. in.

Guard screws (metric) — M6x1

Scope-mounting screws — 6x48

BOLT

Lug shear area — .442 sq. in.

Lug bearing area — .080 sq. in.

Bolt diameter — .699 in.

Lug diameter — .975 in.

Bolt-face counterbore depth — .109 in.

MAGAZINE

Length — 3.48 in.

Capacity: .30-06 Springfield — 5
.243 Winchester — 4
7mm Rem. Magnum — 3

WEIGHT

Receiver group.....21.3 oz.
Bolt group 17.0 oz.
Magazine/floorplate group.....7.7 oz.
Total action weight 46.0 oz.

Carl Gustaf

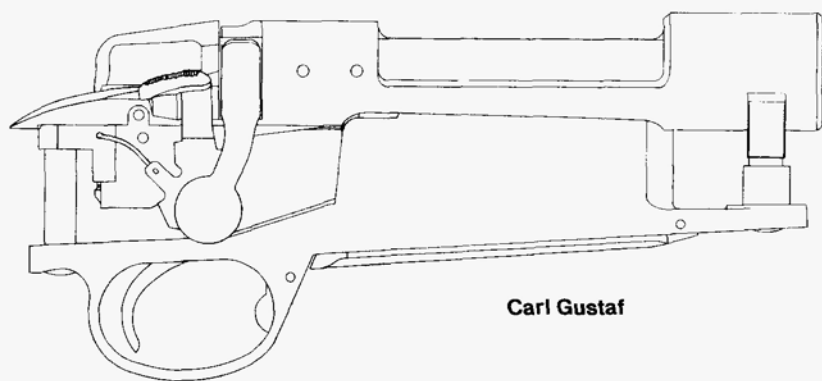


Prior to the Second World War, Husqvarna Vapenfabriks Aktiebolag (HVA) of Huskvarna, Sweden, built sporting rifles for the Swedish market, but mostly on military Swedish Model 94 and 96 Mauser actions. Following the war, HVA began using commercial FN actions made in Liege, Belgium, to build rifles for export. These rifles became available in numbers in the U.S. as early as 1947, distributed in the western states by Tradewinds, Inc., of Tacoma, Washington, and east of the Mississippi River by Eric Johnson Co. of Chicago. In 1952, Tradewinds took over as the exclusive importer, a position they would hold until the late-1960s.

But meanwhile, Husqvarna took steps to end their dependency on imported Belgian actions. In 1953 they began production of their own Mauser action. This "HVA" bolt action was known outside the U.S. as the Husqvarna Model 1640. Unlike FN's action, which was a relatively faithful commercial adaptation of Mauser's perennial Model 98 battle action, the HVA was more a compromise between the Model 98 and the earlier small-ring Model 94 and 96 Mausers with which the Swedes were far more familiar. The Model 94 and 96 had been turned out in large numbers for many years by Carl Gustafs Stads Gevärsfaktori (Carl Gustaf City Rifle Factory) at Eskilstuna, Sweden, and to a lesser extent also by Husqvarna.

This HVA design began arriving in the U.S. through Tradewinds in early 1954 in the form of actions alone and barreled actions. In 1955 complete rifles became available. Much later, in 1968, Smith & Wesson struck a deal to import a line of Husqvarna HVA rifles virtually identical to those imported by Tradewinds, except stamped with the S&W trademark.

While the HVA "improved" Mauser action served the company extremely well in its time, Husqvarna had already decided by the early 1960s that they needed a more up-to-date bolt action. Intended to be functionally superior to the military-oriented Model 1640 and, equally important, less expensive to manufacture with modern



machine tools, development of this second Husqvarna action began in earnest in 1965. Designated the Model 1900, its design layout was done by Gunnar Larsson, an engineer who had a major hand in the development of the Model 1640 a little more than a decade earlier.

Larsson was given much more freedom in designing the Model 1900 action than he had for the HVA, which could be lumped together with several other actions being made in Europe under the general and not particularly exciting category of "commercial Mausers." He in turn rewarded his employers with one of the cleanest and most efficient bolt action designs ever put on paper. And once on the market, it commanded a great deal of attention and admiration, not only from gun critics and potential customers, but from competitors in the trade as well.

Production of the Model 1900 began in 1967 with an initial batch of two hundred rifles. These not only allowed Husqvarna to debug the production line, but the subsequent sale of these rifles in Scandinavia proved their market acceptance. Rifles incorporating the new action didn't begin arriving in the U.S. through Tradewinds until early 1969, and it replaced the HVA action in Smith & Wesson brand rifles about a year after that. The rifles marketed by Tradewinds under the Husqvarna logo came in two grades, the Model 8000 (Imperial Grade) featuring a jeweled bolt and machine-engraved floorplate, and a plainer Model 9000 (Crown Grade).

Two rifle manufacturing facilities existed for many years in Sweden: the privately-owned HVA in Huskvarna, where sporting and military arms were made, and the Carl Gustaf factory in Eskilstuna, owned by the huge Förenade Fabriksverken (FFV) conglomerate, which produced most of Sweden's military rifles. As part of a general move begun a few years earlier to diversify into some consumer fields, FFV in 1969 tendered a very generous offer for

Carl Gustaf

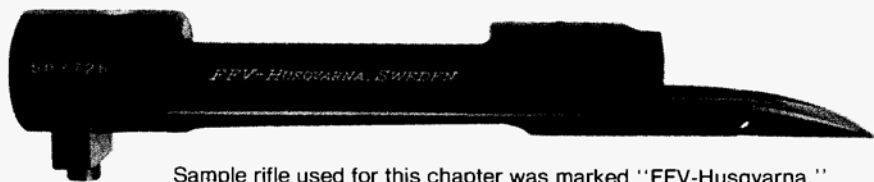
HVA's sporting arms division. In 1970, the entire operation was uprooted and moved 150 miles north to Eskilstuna.

FFV, which had previously done only defense work, formed Viking Sport Arms Co. AB, later renamed FFV Sport AB, with the idea of eventually offering an entirely new and complete line of Swedish sporting arms. Its president was Eric Cläesson, who had previously headed the small arms department at Husqvarna. Gunnar Larsson remained at Husqvarna, and engineering responsibilities for the new division shifted to an FFV engineer by the name of Lennart Johansson.

The pride as well as the cornerstone of this new operation was of course Husqvarna's high power rifle. Part of the purchase agreement, however, specified that the Husqvarna name had to be phased out within ten years. FFV decided to rename the rifle after King Carl Gustaf X, for whom the section of Eskilstuna where their rifle factory is located was named. They wanted to proceed as quickly as possible in that direction, so they could get on with the job of establishing a new identity for the rifle. The rifles were initially referred to by such compound names as "FFV-Husqvarna," "HVA-Carl Gustaf," and "Carl Gustaf (Husqvarna)." After a few years, the name became simply "Carl Gustaf," thus fulfilling the terms of the sales agreement.

Husqvarna's experience in dealing with two different U.S. importers, who not only marketed their rifles under different names but also at considerably different prices, led FFV to sever these arrangements altogether in favor of doing their own marketing in the U.S. A subsidiary company called FFV Sports, Inc. was set up to import the rifles. Located temporarily in New York City, it was soon moved to Billings, N.Y., then finally to Branford, Connecticut, where it was closer to the port of entry. Actions and barreled actions, as well as complete rifles, were offered. In 1973, FFV even added a southpaw version of the rifle.

This subsidiary marketing operation was not overwhelmingly successful. In 1975 FFV Sports was dissolved, with Stoeger



Sample rifle used for this chapter was marked "FFV-Husqvarna."

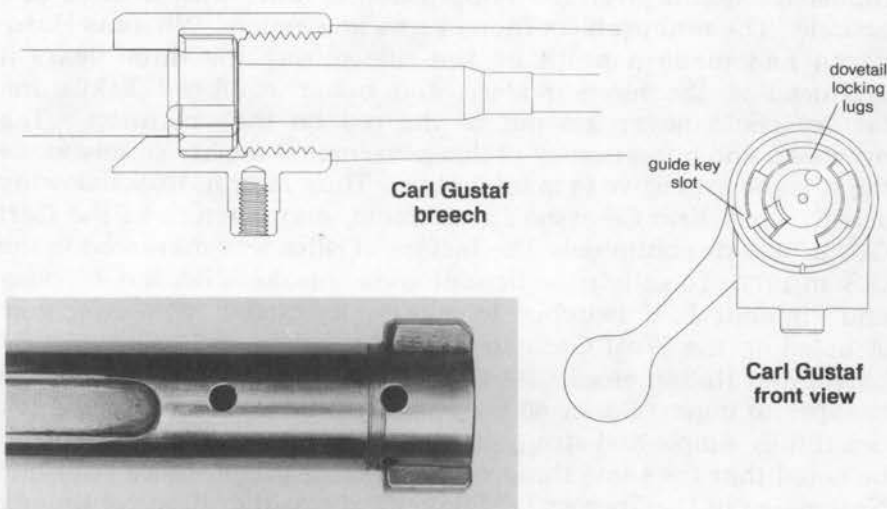
Industries taking over the importation of Carl Gustaf rifles and actions. The real problem though was in Sweden. Whereas Husqvarna had made a profit on the rifle during the three years it produced it, the more modern and better equipped Eskilstuna factory could never get out of the red on the operation. The overhead and bureaucracy of this government facility simply made the rifle too expensive to manufacture. Thus, later in 1975, following shortly upon Eric Cläesson's retirement, manufacture of the Carl Gustaf was discontinued. The last lot of rifles was marketed in the U.S. in 1977. To satisfy the Scandinavian market (Sweden, Norway and Finland), FFV switched to making a "Model 3000" rifle, constructed on the West German Sauer 80 action, and using an FFV barrel and Italian stock. As illogical as it seems that it could be cheaper to import Sauer 80 actions (Chapter 15) than to make the beautifully simple and straightforward Husqvarna design, it should be noted that the same thing occurred in Belgium, where Fabrique Nationale put together an "FN-Sauer" rifle, rather than continuing to make their own bolt actions.

During its roughly ten-year lifespan, approximately 125,000 of these Husqvarna/Carl Gustaf rifles were sold. Besides sales in the U.S., which accounted for about twenty percent of the total output, the basic rifle was also marketed under its Swedish Trademarks throughout Europe, Canada and Australia, and in England under the Holland & Holland logo.

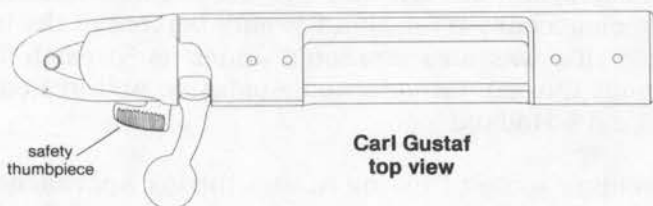
By avoiding some of the more unorthodox approaches of recent times, Gunnar Larsson created a very modern and streamlined action without at the same time abandoning any really fundamental Mauser features. A shallow bolt-face counterbore and carefully proportioned extractor allow seating the cartridge deep into the barrel, as Paul Mauser had done. The forged receiver guides the bolt with special dovetail-shaped raceways, as well as a full-length keyway system. A low-profile bolt handle, which rotates only eighty degrees on opening, is brazed in place, as is the nose of the bolt sleeve, which is unthreaded in favor of a direct flanged attachment to the rear rim of the bolt. Inside the smooth working and strongly cammed bolt is a lightweight firing pin, controlled beneath by a free-floating lever which acts as a combined sear and bolt stop.

Like many rifles introduced in recent years, the Carl Gustaf has very simple breeching, with the barrel shank faced off square to match up against a flat-nosed bolt. Because the dimensional details of each part were very carefully attended to in this rifle, the breech which results is strong and effective. A bolt-face counterbore of minimum depth, coupled with a closely-fitted barrel and the lack of

Carl Gustaf



Underside of Carl Gustaf bolt features two gas ports and a shallow lengthwise groove to cooperate with the head of the sear to stop rearward travel.



any deep chamfer in the mouth of the chamber, results in a cartridge-head protrusion of less than 0.120 inch. This is considerably better than found in most modern bolt actions. And the cartridge head circumference which does protrude from the chamber is encircled by the thick walls of the bolt face counterbore, solid except for a slot on the right side for the extractor.

The receiver ring is free of gas ports. Two holes drilled into the side of the bolt body, however, deal with any pressure entering by way of the firing pin hole. One hole is at each point where the bolt interior expands in diameter to accommodate the firing pin assembly, and both release pressure into the left receiver raceway, where it combines with any gas that might escape directly around the bolt head. This raceway is in turn blocked off at the bridge by the front flange of the bolt sleeve. Flow back along the opposite raceway would be largely dissipated by the loading port. The back wall of the bolt sleeve forms a shroud, in case either the firing pin or gas pressure drives back through the center of the bolt. A hole

Carl Gustaf

violates this rear shroud, but only to the extent necessary to accommodate a "cocking indicator" on the rear of the firing pin shaft.

The Carl Gustaf receiver is a carbon steel forging, case hardened after machining. Contrary to the opinion of some early reviewers, it was never investment cast, nor welded from two pieces. Considering its essentially cylindrical nature, it would of course have made some sense to have constructed this receiver more on the order of the Remington Model 700, starting with barstock and then simply clamping a recoil lug plate in front at the same time the barrel is installed. According to Gunnar Larsson, however, Husqvarna placed a great deal of importance on the strength and integrity available in a forging.

FFV retained the integral recoil lug when it started making the receivers in Eskilstuna, but switched to a different forging process to save production costs. Instead of the conventional open-die method used by Husqvarna, which among other things left a heavy parting line which had to be cleaned away, a "longitudinal" forging process was used. Starting as merely a simple piece of round barstock, the receiver blank was fed into a closed forging die from one end, working the metal to final dimension, and forming the recoil lug at the front.

After machining, the receiver ends up almost an example of metal-working art, with exceptional styling and finish. Formed on a basic 1.3-inch diameter, the bridge was milled down on top to help give a balanced and attractive overall contour. The tang is also trim, and nicely rounded at the back, yet retaining enough metal for good stiffness.

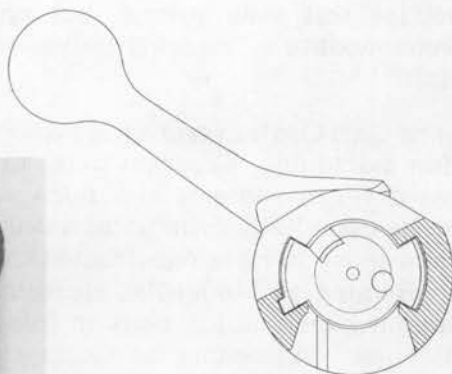


Perfectly clean profile on left side of Carl Gustaf receiver is characteristic of overall action.

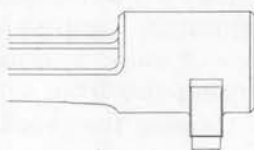
Carl Gustaf



While Carl Gustaf (left) has guide keyway, it does not remove as much metal from receiver ring as, for example, that in the Savage 110 (right).

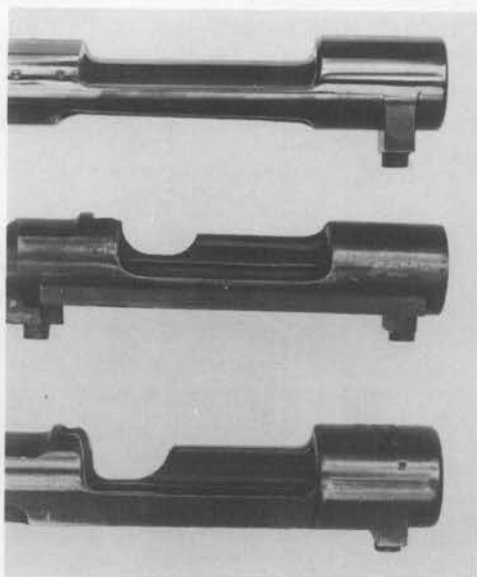


**Carl Gustaf
receiver midsection**



**Carl Gustaf
barrel attachment**

Trim receiver of Carl Gustaf rifle (top) is based on Mauser's early 1.3-inch diameter receivers (middle) rather than the larger-diameter version used in his more-famous Model 98 pattern (bottom).



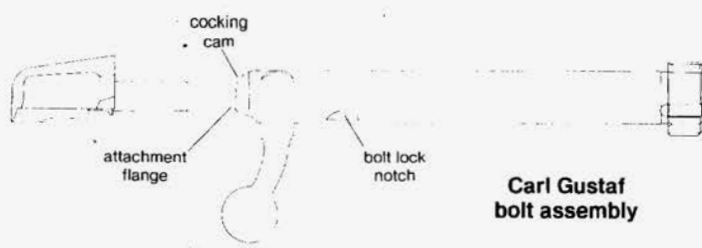
Carl Gustaf

The inside of the receiver is drilled and reamed for the boltway, then broached the entire length for the locking lugs, in the process removing most of the threads for the barrel on a strip along each side of the receiver ring. In addition to the lug raceways proper, a guide slot is cut along the lower edge of the right raceway. This slot is part of a keyway guide system which Husqvarna helped pioneer in modern bolt actions design (U.S. Patent 3,416,253 issued December 17, 1968 (S.G.O. Larsson)).

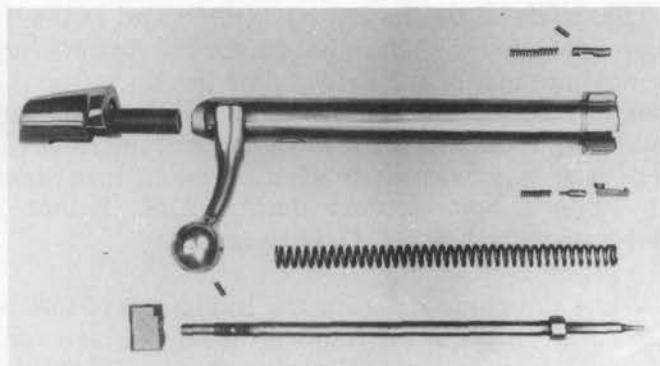
While the guide slot runs the full length of the receiver, relatively little wall thickness is removed from the receiver ring as a result. The slot is in fact essentially flush with its inside diameter in the critical locking area, and therefore, unlike similar keyways later used in some U.S. rifles, has little if any detrimental effect on strength.

In many sporting rifles built in West Germany, the barrel threads, and sometimes even the outer diameter of the receiver ring, match the Mauser Model 98, Germany's military bolt action. Interestingly enough, an analogous situation applies to the Carl Gustaf rifle. The Swedish Army, however, adopted Mauser's earlier Model 94 and 96 patterns, which preceded the switch to an enlarged (1.4-inch diameter) receiver ring. Thus the Carl Gustaf has the same small-diameter receiver ring and barrel threads as the pre-Model-98 Mausers.

The bolt is an all bright-finished part, which, like the receiver, very artistically combines style and function. Its body is cut from a single length of carbon steel barstock. A flat milled at the back forms a base onto which an investment-cast handle is copper brazed, a high temperature oven procedure which allows subsequent heat treatment of the bolt without any effect on the joint. The sleeve attached behind the bolt is also a beautifully styled and finished part, and copper brazed together from two individual pieces. Its long cylindrical nose fits closely into the rear of the bolt to support the firing pin and mainspring.



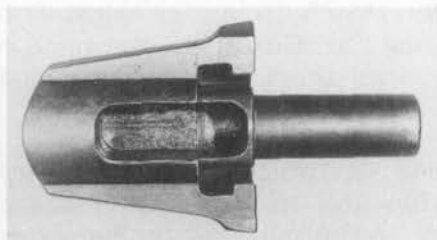
Carl Gustaf



Design of bolt and firing pin assemblies is clean and simple. Firing pin is locked with a simple cross pin, despite shrouded bolt sleeve. Some early firing pins made by Husqvarna had separate mainspring flange.



Dovetail shape of locking lugs gives Vee-way type support in receiver raceways, while tongue protruding on right side controls rotational play.



Though exceedingly difficult to detect, the bolt sleeve is brazed together from two pieces.

This nose is unthreaded and unlugged. Attachment is instead by way of a circular groove in the front flange of the bolt sleeve, which hooks on a flange on the rear rim of the bolt body. Machined into the roof of the bolt sleeve before the nose portion is brazed into place, this groove combines ease of field stripping with the kind of strength normally associated only with a threaded bolt sleeve. Besides this unconventional attachment system, the interior of the bolt sleeve assembly is milled out inside an extra amount to allow communication of cocking cams which are exactly 180 degrees out of phase with the usual cam arrangement.

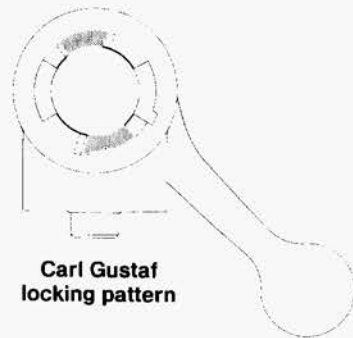
The Carl Gustaf locking lugs are cut on a dovetail pattern, with flanks formed by sixty-degree radial lines originating from the bolt centerline. This cross-sectional shape was a fundamental ingredient in Larsson's patented guiding system concept, giving lateral support to the bolt in a somewhat similar fashion to the Vee-ways

Carl Gustaf

in a high-quality machine tool. A tongue projecting from the lower flank of the right lug also follows the special guide slot broached along the interior of the receiver. This restricts rotational play, particularly when the bolt head is back free of the receiver ring.

The sum effect of these two features makes possible a smooth and non-binding bolt operation without excessively close fitting parts. Consequently, this Swedish product is easily one of the smoothest and freest working bolt actions ever to appear on the market.

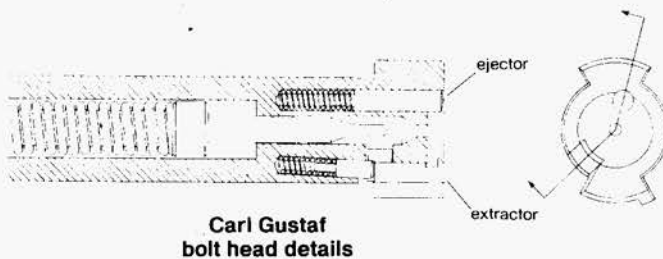
From a breeching standpoint, these lugs function quite satisfactorily, yet their shape yields no surprising or spectacular statistics. Shear and bearing areas are about 0.35 and 0.07 square inch respectively, pretty average figures for modern high-power rifles.



Carl Gustaf
locking pattern

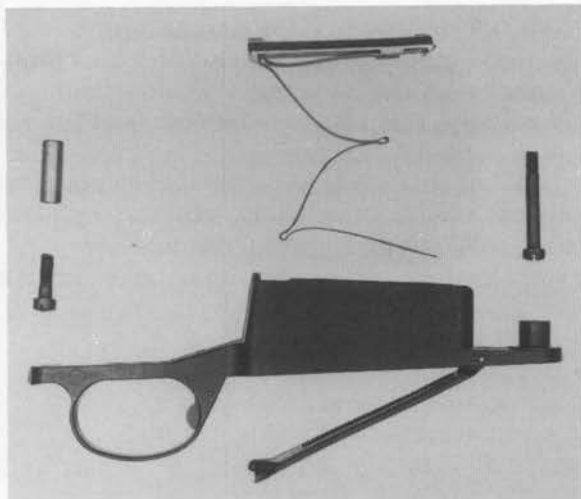
Larsson's original prototype design of this rifle had a sliding-plate extractor, recessed in the right locking lug, and controlled by a wire spring in an arrangement much like that now used in Browning's BBR rifle (Chapter 17). But for the production rifle, a more conventional pivoting latch-type extractor was used, positioned in the bolt head just above the right locking lug and retained by an angled foot machined at its base. A spring-loaded plunger traps it in place, yet yields enough so that the extractor claw can expand over a cartridge rim during bolt closure. Built into the opposite side of the bolt face counterbore is a spring-loaded pin ejector.

The magazine and trigger guard assembly, die cast from aluminum alloy as a single piece, is the same part used on the HVA action. It is supported by two limited-compression guard screws. An integral bushing surrounding the front guard screw cooperates with



Carl Gustaf
bolt head details

Carl Gustaf



Die cast aluminum assembly is supported by two guard screws. Spacer surrounding rear guard screw also holds up trigger housing.

Follower piece has an upper flange (A) which contacts underside of receiver to prevent empty magazine from rising fully.



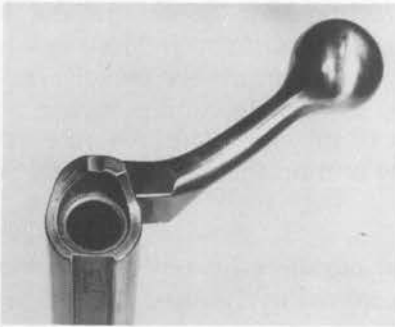
a flange projecting down from the recoil lug of the receiver to limit takeup, while a steel spacer piece serves the same purpose at the rear, plus also clamping the trigger in place. The magazine is closed by a hinged aluminum floorplate.

Inside, the magazine walls are straight, with the cartridge feed lips milled entirely into the structure of the receiver above. The follower piece is a nicely finished steel part, supported by a W-shaped ribbon spring, and flanged at the top to prevent rubbing against the bolt when the magazine is empty.

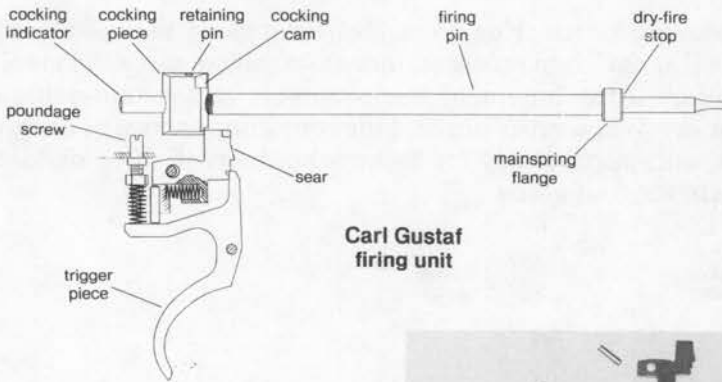
The cams in the Carl Gustaf rifle are geometrically proportioned to give good displacement and leverage. Combined with surfaces which are exceptionally well finished and blended, this renders the kind of smooth and positive operation all too often lacking in modern bolt actions. The only really unorthodox camming feature involves the location of the cocking cams, which work up in the roof of the bolt sleeve, rather than underneath adjacent the receiver floor.

Carefully designed and proportioned, the one-piece firing pin is

Carl Gustaf

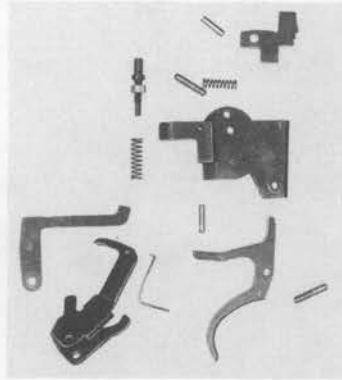


Top location of cocking piece cam results in a bolt-rim notch which is exactly 180-degrees out of phase with usual Mauser arrangement.



**Carl Gustaf
firing unit**

Except for a "free-floating" sear, design and construction of trigger assembly is rather undistinguished. Engagement is not adjustable. Because of bolt stop, neither is overtravel.



guided in both the bolt and the bolt sleeve. It threads at the rear into a very compact cocking piece, locked in place by an angled cross pin. Despite an extension or tail at the rear, protruding almost a half inch to serve as a cocking indicator, this firing pin assembly weighs only just over 1½ ounces, thus contributing to a fast lock time without resort to overly stiff mainsprings.

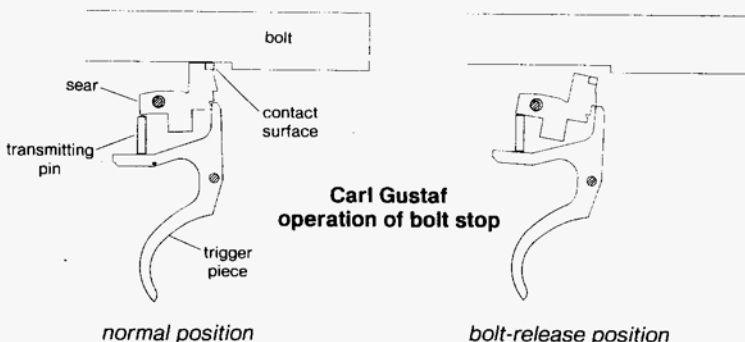
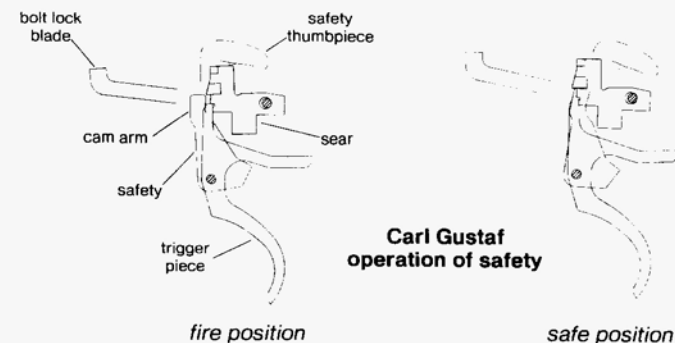
The trigger assembly, comprising the trigger, safety and bolt stop, is covered by the second U.S. Patent issued for this rifle (3,949,509, issued April 13, 1976 (S.G.O. Larsson)). The trigger has a basic over-ride geometry. A pivoted sear is supported by the head of the trigger

Carl Gustaf

piece, with the engagement surfaces on both pieces ground and lapped for smooth and even release. Also contributing to consistent shot-to-shot letoff is the fact that the sear pivots loosely on an enlarged hole, and is positioned by a laterally-acting spring. This allows free, non-binding movement of the parts, while at the same time ensuring a precisely repeatable and uniform engagement each time the trigger resets.

With the bolt removed, the trigger can be adjusted for poundage by turning a small slotted screw recessed in the tang. There is no adjustment for either engagement or overtravel.

The housing for the trigger is a U-shaped piece, blanked and folded from steel sheet, then soldered into slots milled in a solid steel block at the rear. Attachment of this assembly to the underside of the receiver involves a cross pin and the rear guard screw spacer, not an ideal layout, particularly for those who distrust rifles bedded with spacers in the first place.



The two-position safety is another U-shaped sheet-metal part. One arm forms a generous-sized serrated thumbpiece, positioned for operation up alongside the receiver tang just behind the bolt handle notch. The other arm terminates in a hardened cam which engages the underside of a ledge projecting from the side of the sear. Operating in unison is a long L-shaped lever which reaches forward to lock the bolt. The entire assembly pivots on the trigger pin and is detented in its two positions by a "snap-over" wire spring.

When the thumbpiece is snapped forward to the *fire* position, the safety cam moves just clear of the sear, freeing it to drop when released by the trigger piece. The bolt-lock blade also disengages from the bolt. Pulled back to *safe*, the cam arm slides beneath the sear, camming it upward about 0.015 inch off the top of the trigger. Simultaneously, the bolt-lock blade rises through a slot in the receiver to lock into a special notch milled into the side of the bolt.

The trigger mechanism doubles as a bolt stop. Its sear projects up to engage a shallow lengthwise groove milled in the underside of the bolt. At the end of the bolt's rearward travel, the radiused front nose of the sear contacts the blind end of this groove. Due to a rather thick head, the sear can survive normal pounding without damage. Despite an enlarged pivot hole, the sear's pivot pin is not similarly protected, and thus is vulnerable to getting battered from any really heavy bolt impact.

Because the bolt is already so closely controlled by its locking lugs, the groove along its bottom surface is cut wide enough to generously clear the head of the sear on each side, thus playing no role as a guide. Both removal and insertion of the bolt involves a "transmitting pin" located just behind the trigger piece. While short enough not to interfere with normal trigger function, this pin tilts the sear down flush with the receiver boltway when the trigger is pressed fully back.

Summary

If prizes were awarded in firearms design, this Carl Gustaf rifle would surely be at or near the top in the category of commercial bolt actions. The short lifespan of what Eric Cläesson described as the "pearl" of FFV's sporting arms line is thus particularly ironic and regrettable.

It was neither perfect, nor remarkably novel or innovative. The trigger could use some work, and a lot of people didn't care much for the die-cast trigger guard. A safety thumbpiece made from

Carl Gustaf

something other than sheet metal would have looked a lot nicer. Yet it was overall a refreshingly sound and well balanced action, crisp and uncluttered, and embodying consummate good taste. It exuded precision and workmanship, and functioned with a smoothness rare in modern rifles.

The following summarizes the strong and weak points of the action:

Strong points:

1. Exceptionally clean and attractive lines.
2. Excellent bolt-guiding system.
3. Smooth and positive functioning.
4. Positive and convenient safety.
5. Efficient lock mechanism.
6. Minimum cartridge head protrusion.
7. Easy field stripping.

Weak points:

1. Sear bolt stop.
2. Trigger with limited adjustments.
3. Spacer mounting of trigger housing.

Carl Gustaf Dimensions

OPERATING

Extraction: set-back — .11 in.
leverage — 9 to 1

Chambering: cam-forward — .12 in.
leverage — 11 to 1

Bolt rotation — 79°

Bolt travel: .222 Remington — 3.53 in.
.308 Winchester — 4.00 in.
.30-06 Springfield — 4.44 in.

Cock-on-opening; .323 in.
mainspring compression
proportioned as follows:
opening — .237 in.
closing — .086 in.

IGNITION

Firing pin travel: at impact — .269 in.
dry-fired — .323 in.

Lock time — 3.0 ms.

Impact velocity — 16.2 ft./sec.
energy — 85.3 in.-oz.
impulse — .88 oz.-sec.

Striker/firing pin hole diameters — .076 in./0.079 in.

RECEIVER

Overall length — 9.00 in.

Length of loading/ejection port — 3.16 in.

Ring diameter — 1.290 in.

Barrel threads — .98 - 12

Recoil-lug bearing area — .45 sq. in.

Guard screws (metric) — M6x1

Scope mounting screws — 6 x 48

BOLT

Lug shear area — .349 sq. in.

Lug bearing area — .070 sq. in.

Bolt diameter — .700 in.

Lug diameter — .937 in.

Bolt-face counterbore depth — .107 in.

MAGAZINE

Length: .222 Remington — 2.40 in.
.308 Winchester — 2.97 in.
.30-06 Springfield — 3.39 in.

Capacity: .222 Remington — 6
.308 Winchester — 5
7mm Remington Magnum — 3

WEIGHT

	.222 Remington	.308 Winchester	.30-06 Springfield
Receiver group	18.6 oz.	18.6 oz.	18.6 oz.
Bolt group	14.1 oz.	13.9 oz.	13.9 oz.
Magazine/floorplate group	8.1 oz.	7.0 oz.	7.2 oz.
Total action weight	40.8 oz.	39.5 oz.	39.7 oz.

OMEGA III

Omega III

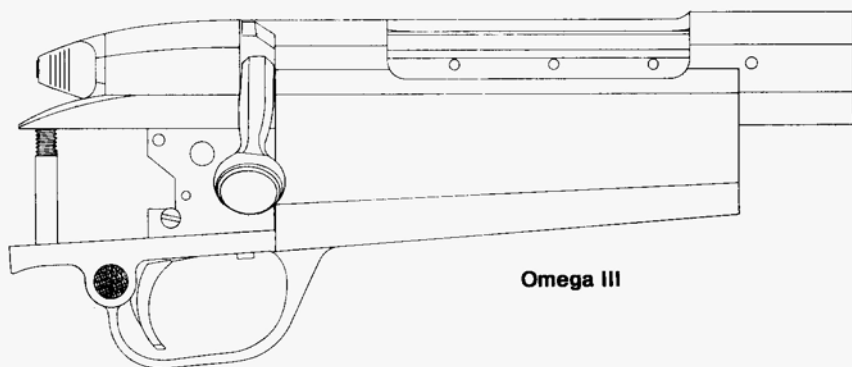
Upon leaving Ranger Arms in April 1970, Homer Koon relocated in Denton, Texas, to organize a second rifle project. He started by rounding up sufficient stockholders to finance a research and development operation, incorporated as "Firearm Development" in September 1970.

Within a year Koon had made enough drawings and calculations to apply for a series of patents. He had become a most ardent believer in these pieces of paper, not just as protection for design novelty, but as a marketing tool also. The following patents were issued on the new rifle, each carrying Koon as the inventor, and assigned to Firearm Development, Inc., of which Koon was the major stockholder.

<i>Patent No.</i>	<i>Subject</i>
3,739,515	uniblock receiver
3,745,683	four-cornered locking system
3,745,686	octagonal bolt
3,745,687	rotary magazine
3,755,947	top-guided cocking piece
3,755,951	counter-spring trigger

Funded by the same group of investors, "Omega Arms" was incorporated in February 1972 to manufacture and market the rifle designed under Firearm Development, Inc. A new building and manufacturing facility, set up in Flower Mound, Texas, on a dairy farm owned by one of the stockholders, was officially opened on September 23, 1972. As with Ranger Arms five years earlier, elaborately engraved presentation rifles were given away, this time not only to John Connally, Herb Klein and Homer Koon, but with actor John Wayne invited from California to join the list. Each of the local investors also received a rifle, but without the fancy metalwork.

Koon's plans were based on making and selling at least 150 rifles



Omega III

a week. In fact, they seldom finished more than five or six rifles in any given week, and over a two-year period less than 500 rifles were built. Aside from some specific design and production problems, the basic rifle was simply too expensive and time-consuming for Omega Arms to profitably manufacture. They couldn't generate enough income to even cover production costs, say nothing of keeping up payments on the investments in facilities, machinery and promotion.

After unsuccessful efforts to refinance the corporation locally, Koon tried to interest several gun companies in the idea of buying into Omega Arms. The closest he came to succeeding on this tack was getting Smith & Wesson to come down to survey the operation. By late summer 1974 production efforts had come close to a standstill, and Koon was forced to abandon the facilities at Flower Mound, placing as much of the inventory and machinery as he could into storage in Dallas.

Help finally arrived later that year from a rather unlikely quarter. Koon had earlier done some negotiating with a firm in Torrance, California, for the marketing rights to the Omega rifle in the Western states. One of the partners in this company (M & N Distributors) happened to also manage the Ordnance Division of the Hi-Shear Corporation, which, at that time, was considering adding a "commercial products" line to its usual output of military gear. While Hi-Shear had no interest in "investing" in Omega, it did agree in November 1974 to buy Omega out. Everything that was left — rifles, barrels, actions, parts, drawings, machinery and tooling — was loaded into two tractor trailers for the trip West to Hi-Shear's Ordnance Division just south of Los Angeles. Koon even went along with the deal, on a six month contract to assist in getting the rifle into production in California.

As sometimes happens, the deal went through without undue

Omega III

participation by the working level engineers and production specialists at Hi-Shear. When they did finally get an opportunity to unpack things and take a good look at the design in early 1975, there was a great deal they didn't like. Thus, despite the fact that management expected "Hi-Shear" rifles ready for display at the 1976 NSGA Show, less than a year away, a rather fundamental "reengineering" project was undertaken. While this rendered very little noticeable change in outward appearance, the method of fabrication and the detailed inner workings of the action underwent extensive revision at Hi-Shear.

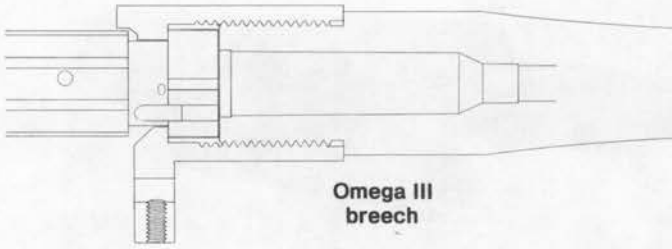
As it ended up, rifles were displayed at both the 1976 and 1977 NSGA shows. Despite investing a lot of money and making a lot of parts, however, Hi-Shear wound up with even less in the way of tangible results than Koon had. When they finally gave up on the project in late 1977, only 28 complete rifles had been assembled, eight of which were sold!

As can often happen, Koon's rifle design ideas were becoming less orthodox as he gained experience. He went to a "uniblock" action, sandwiched between a two-piece stock, a construction previously reserved for certain types of shotguns and non-bolt type rifles. The entire action was fashioned on an octagonal motif, a move perhaps inspired by his rifle-building friends in Oklahoma. Recoil was absorbed by the rear walls of a rotary magazine, which featured inside a spring-driven flipper to move the cartridges. Not only did the exterior of the action look octagonal, but so did the bolt, except at the head where it was milled off at four places to form a "square" locking pattern. Inside, the firing pin had exceptionally short lock time due to a thick mainspring, and was guided symmetrically at the rear by a special bolt sleeve. On the back of this bolt sleeve was part of a dual safety system, the other half being located underneath in the trigger guard.

The breech of the Omega III rifle is similar to that of the Texas Magnum, except for a .030 inch deep chamfer inside the bolt face. Intended to help center the Omega bolt head on a chambered cartridge, this chamfer in effect increases the rifle's "breech gap." Incorporating the necessary concentricity directly into the design and manufacturing phases would thus have been a much better solution.

Koon employed the usual array of gas-handling features in the Omega action. A gas port is drilled into each side of the receiver ring. Back at the bridge, a massive shrouded bolt sleeve blocks both escaping gas and a rearward blown firing pin. Finally, three gas ports are drilled into the side of the bolt body, as on the Texas Magnum, Weatherby Mark V, etc.

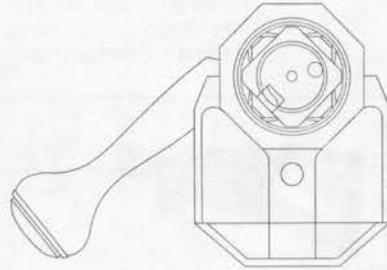
Omega III



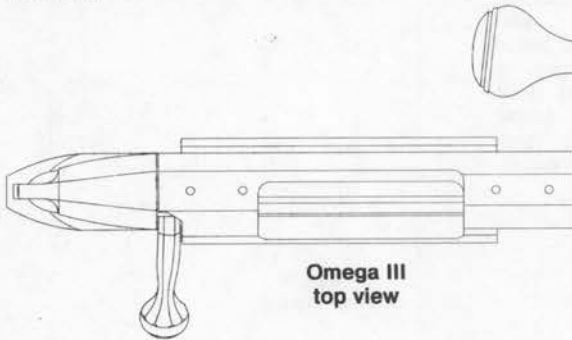
Omega III
breech



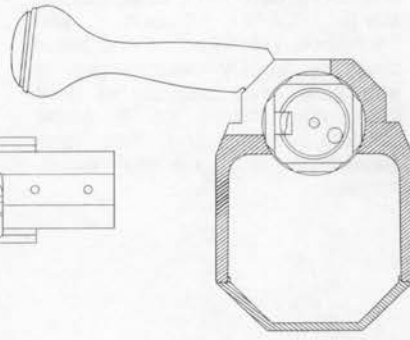
Rear face of Omega III barrel is faced off square, but radiused slightly at chamber entrance.



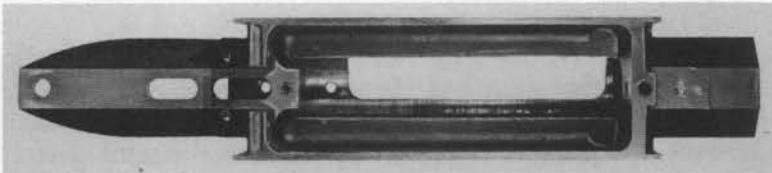
Omega III
front view



Omega III
top view

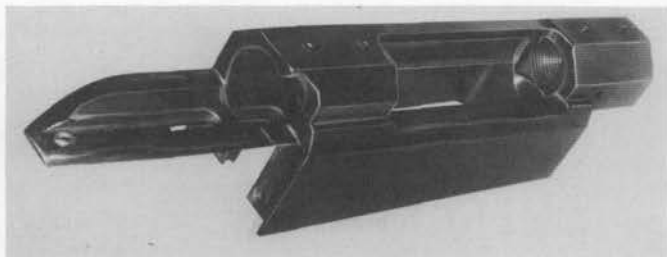


Omega III
receiver midsection

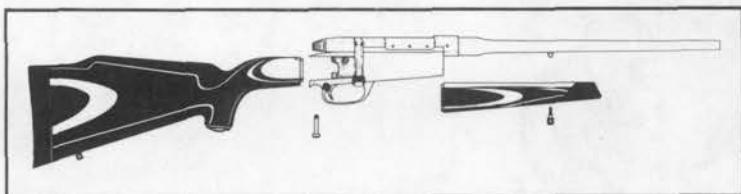


Deep shroud connects octagonal receiver ring and tang. Loading port on top was milled out after casting, in order to allow both right and left-hand receivers without investing in two different casting moulds.

Omega III

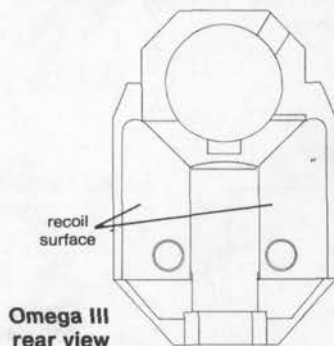


Hulking Omega receiver, perhaps the most intricate since the nineteenth century Krag, would have been obviously infeasible without investment casting.



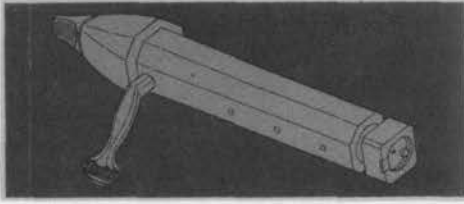
Interchangeable stock design — butt stock and forend quickly detach for shipping or storage with no effect on scope alignment or accuracy. Extra stocks may be ordered to offer a quick selection of styles, or a shorter stock for use of son or wife.

While marketed only as a complete rifle, there were three basic stocks; Monte Carlo, Classic, and Thumbhole-Varminter. Since these could be quickly interchanged, it was considered possible to have three rifles based on a single barreled action, and thus was derived the "III" in the rifle's designation.



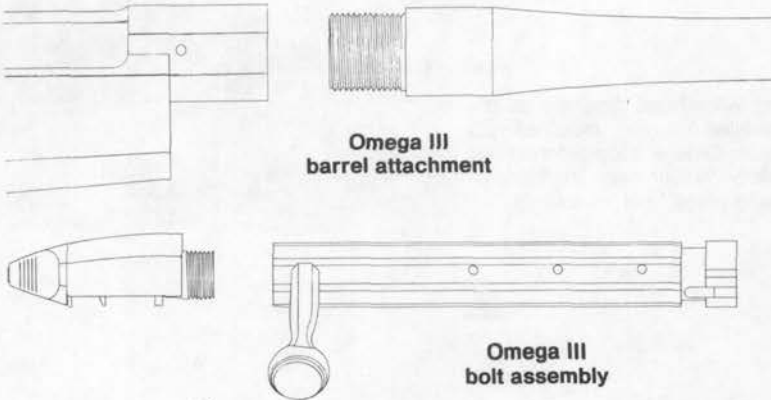
The receiver has an integral magazine housing extending completely down to the floorplate cover. By eliminating the wood along its sides, this "uniblock" receiver allowed a rotary-magazine rifle without an overly wide midsection. The all-metal construction also enabled a trigger guard safety to control a trigger attached to the receiver, an obviously impractical approach if a section of wood is sandwiched in between. The exposed metal sides also formed an ideal showcase for fancy engraving and other embellishment. Finally, the receiver had a lot of rigidity, plus recoil surfaces which form naturally behind the magazine and give far greater recoil area than the separate lug formed under the receiver ring of most Mauser-pattern actions.

Omega III



Octagon bolt, square locking system — unique octagon bolt utilizes the “peaks” as bearing surfaces, greatly reducing friction and providing a smoother operation with less effort and closer tolerances. Square locking system with enclosed bolt face offers extra strength with a short 50 degree lift.

Despite claims in this brochure cut, the bolt was not true octagon, nor did its square locking system add extra strength.



**Omega III
barrel attachment**

**Omega III
bolt assembly**

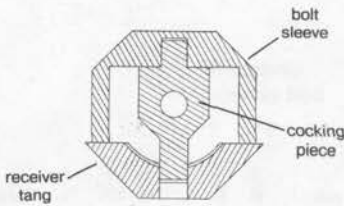
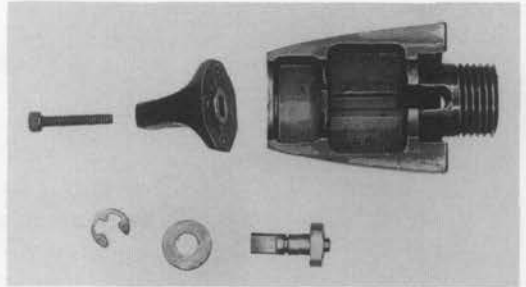
These receivers were investment cast, a source of problems which plagued Koon to the very end of his efforts to manufacture the Omega rifle. He perhaps got off on the wrong foot initially by getting the casting done locally in an attempt to save money. While the prototype rifles, cut from solid billets, came out very nicely, the cast production versions tended to show surface pitting when milled down to final size. Some were salvaged by sand-blasting before bluing, but most customers wanted a high-polish finish, in which case a pitted receiver was little more than scrap. When alloys were added in an attempt to eliminate the porosity, the final blued parts took on an unattractive reddish hue. The problem went back and forth without solution, in the process costing money and lost production the company could ill afford.

Inside the octagonal receiver was a so-called “octagon” bolt. In reality it was nothing more than a .870 inch diameter cylinder into which seven lengthwise flats were milled to reduce contact area with the bore of the receiver. The bolt actually bears on what remains of the original cylinder. It thus differs from a Weatherby-type “fluted” bolt only in the sense that the flats are so large that the Omega bolt actually begins to lose the appearance of a cylinder.

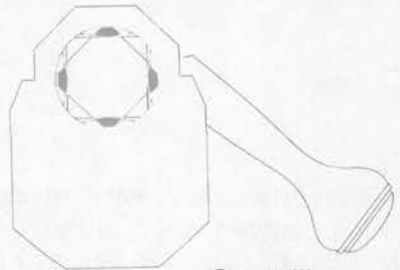
Omega III

The investment-cast bolt sleeve has octagonal styling matching just about everything else in the action. Inside it is partitioned into two compartments, one for the cocking piece and a second rear compartment for the safety spindle. The roof of the forward compartment forms a special upper guide, which combines with the usual lower slot in the rear tang to help balance the cocking piece as it is cammed back during bolt opening.

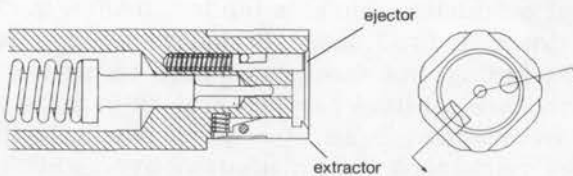
Long Allen-head machine screw controlled force required to operate Omega's top safety. Four shallow holes cast in face of "thumbpiece" act as detents.



**Omega III
guiding of cocking piece**



**Omega III
locking pattern**



**Omega III
bolt head details**

Square Omega bolt head locks on each of its four corners on relatively small locking seats, one of which can be seen here in interior of the Omega receiver ring.



Omega III

The head of the bolt has four locking lugs. Rather than being broached or milled out as distinct lug forms, the bolt head is simply squared off, each resulting corner forming a lug. This locking arrangement was in keeping with Koon's search for the ultimate shear strength. He had juggled around the dimensions and proportions of the locking lugs in the Texas Magnum rifle (Chapter 6) with the idea of favoring shear. In the Omega he simply abandoned traditional lug and seat shapes altogether. Each lug forms a small triangle, with the shear plane running along its base.

While a high percentage of each lug thus acts in shear, they aren't very large. Total shear area is really no greater than in most two-lug Mauser type actions, while the triangular shape renders relatively little bearing surface, significantly less in fact than found in many conventional layouts.

The extractor is a small, pivoted latch fitted midway along one edge of the bolt head. Urged into engagement by a light coil spring, its small claw grasps only about one-tenth of the cartridge head circumference. The ejector, a spring-powered pin, is located on the other side of the bolt-face counterbore, on a line about 30 degrees off the horizontal.

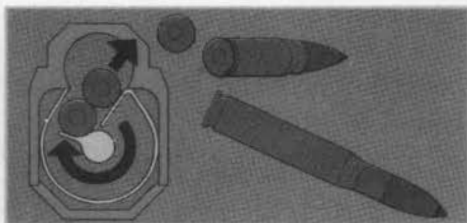
Cartridges are stored and fed from a rotary magazine, although far different from the type normally associated with something like a Mannlicher-Schoenauer or Savage rifle. The traditional advantage of the rotary magazine is smooth feed, but it is usually wider than a Mauser box magazine and more expensive to manufacture. As noted earlier, Koon solved the width problem with his uniblock receiver. Cost was minimized by using a thin sheet metal housing with a simple flipper or paddle inside, in place of a precision housing and inner spool.

Koon had experienced a lot of feed problems with the Texas Magnum rifle, which may account for the fact that he wasn't content to leave the naturally good feed characteristics of the rotary magazine alone. He wanted to position the top cartridge up closer to the centerline of the receiver than is normally possible. This would give the bolt a better purchase in stripping it forward, plus a straighter shot into the chamber.

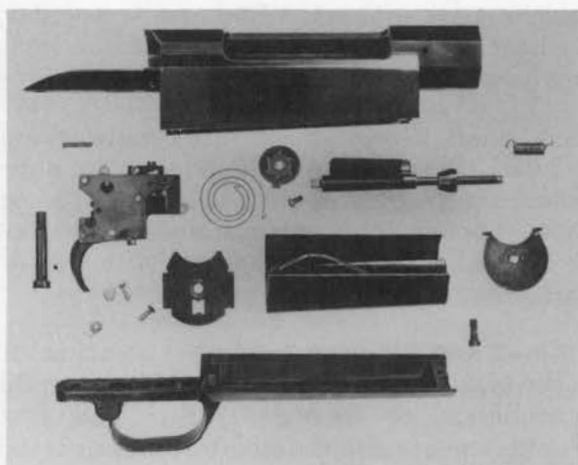
In previous magazines (box type or otherwise), initial cartridge height had always been controlled by some form of "gating" system, generally consisting of lips in the magazine opening of the receiver, or in the magazine itself. Koon simply eliminated the gate, instead allowing the top cartridge to lay free on top of the

Omega III

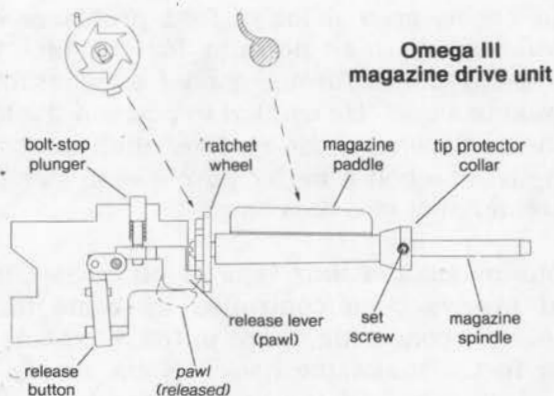
Rotary magazine — one of the smoothest feed systems ever developed. Holds five standard cartridges or four belted magnums, with built-in point protectors. A quick release button allows unfired rounds to spin out the loading port for fast and easy emptying of magazine. Uniblock construction offers a solid lower unit to prevent floorplate "accidents" and reduces the entrance of dirt, snow and rain.



Cut from Omega III brochure giving somewhat fanciful depiction of magazine operation. Unfortunately, this could also occur when simply walking, running, riding on horseback, or in a jeep over rough terrain.



Omega's magazine system, made up of a most peculiar collection of parts, is housed within solid midsection of action. Rather than a long "truss" bolt used in many two-piece stocks, a simple rear guard screw clamps the butt stock to the receiver.

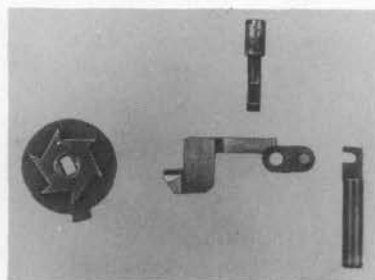


Omega III

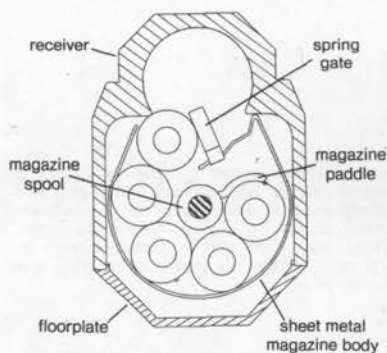
magazine. This not only put it up nice and high for feeding, but avoided any resistance to being stripped forward. To make this possible, the magazine spring was "decoupled" from the cartridge column at specific intervals with a ratchet and pawl timing system keyed to bolt movement via the bolt stop plunger.

It should, however, have been immediately and manifestly obvious that a practical high-power rifle can't simply leave a round sitting loose in the receiver, like a golf ball on a tee. It must be captured and positioned by a positive gating system. Unless these early Omega rifles were held reasonably level and stable during operation (an obviously ridiculous requirement for a hunting rifle), the top cartridge could get tossed out of position, if not out of the rifle altogether. Thus, the owners of the first batch of Omega rifles found they weren't particularly well suited for maneuvering on foot over rough terrain, say nothing of riding jeeps or horses.

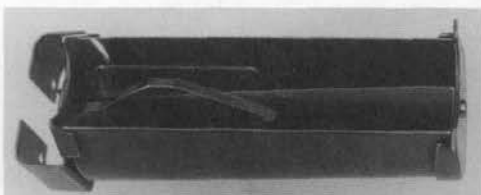
The rifles were in production only a short time before Koon was forced to devise a gate to make the magazine functional. Consisting of a thin metal blade spring fitted at the mouth of the magazine, it blocked the exit, yet yielded in the opposite direction



Standard magazine held five cartridges, and six-toothed ratchet wheel, the last tooth simply acting as a stop. Five-toothed ratchet was used for belted magnums. Bolt stop plunger (top) allowed bolt movement to control pawl, and thus rotation of the magazine spindle.



**Omega III
rotary magazine**



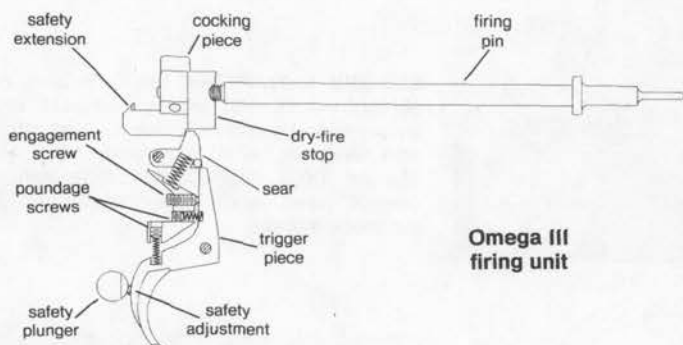
Rather cheap looking ribbon spring attached to magazine opening was a modification to prevent the top cartridge from being tossed off the magazine.

Omega III

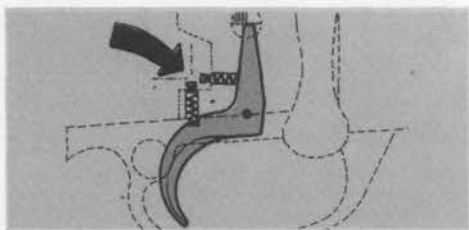
to allow charging with fresh cartridges. It also rendered the ratchet and pawl apparatus entirely superfluous, although it was all retained inside the magazine anyway.

The inner housing of the magazine comprised several sheet metal parts. Through its centerline is a spindle, journaled at each end, and driven in a clockwise direction by two springs. A thin torsion spring acts at the front, and a band spring somewhat resembling the mainspring of a pocket watch, at the rear. A "paddle" on the spindle actually drives the cartridges, while a collar can be positioned along its length to protect bullet points against recoil. Underneath, a one-piece floorplate and trigger guard unit closes off the bottom of the magazine area.

Due to a limited bolt rotation, the extraction and chambering cams in the Omega rifle are small. The cocking system isn't particularly geometrically effective either, and must overcome the additional problem of an exceptionally heavy mainspring. While Koon used a special dual guide system in the bolt sleeve to minimize bending and cramping of the firing pin, operation of the bolt is not smooth and easy, and there is an especially annoying "jerky" aspect to the closing cycle.



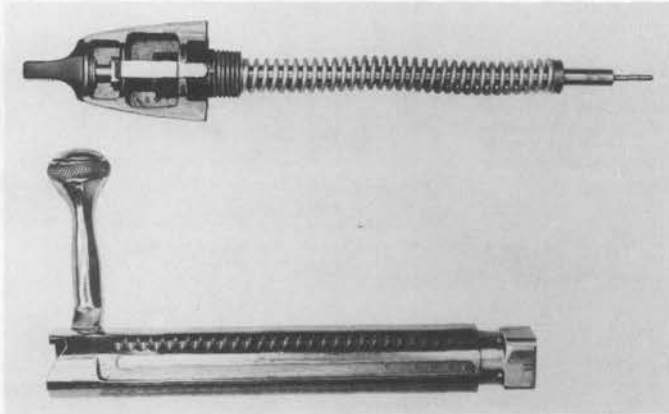
**Omega III
firing unit**



Counter-spring trigger — counter balanced springs pushing against each other give full control over poundage for very fine adjustments without removing mechanism from action. Has adjustment for travel or creep as well as poundage, to give a very crisp and positive let-off.

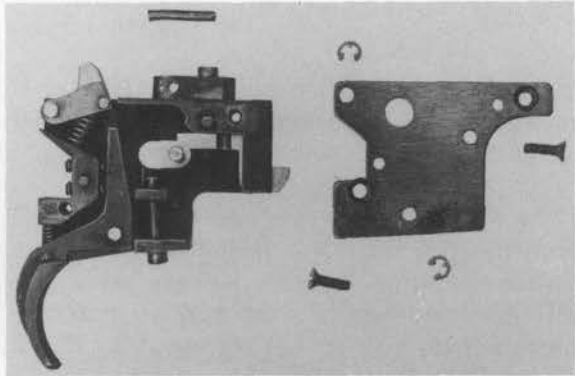
Brochure cut proclaims virtues of "counterspring" trigger. Elsewhere there were also claims of a more "constant" trigger pull. If anything, an opposing spring renders coarser adjustments and a less uniform resistance to pull.

Omega III



Massive Omega mainspring gave exceptionally fast lock time. Eighth flat is omitted from bottom of "octagon" bolt in order to leave extra metal for milling guide groove. Top safety, shown at rear of bolt sleeve, was omitted from the Hi-Shear rifles, and even some of the last rifles Koon produced.

Trigger assembly, made up mostly of investment castings, is covered on the side by a blanked steel plate, and attached to the receiver by means of a single roll pin.



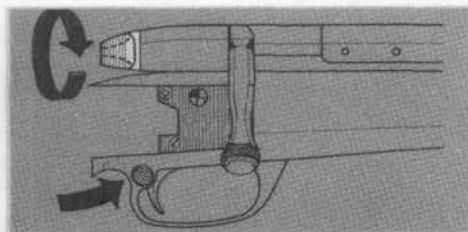
The firing pin assembly resembled that used in the Texas Magnum rifle, except it is about a half ounce lighter, giving the Omega III an even faster lock time. The trigger also bears resemblance to that used in Koon's first rifle. It is, however, a neater and more compact assembly. More important, it is pinned to the receiver rather than floating down on the trigger guard.

Three small Allen-head screws regulate the trigger, two of which are arranged to oppose each other in a patented "counter-spring" arrangement for weight-of-pull. The other acts behind the trigger piece to set sear engagement. All three screws are accessible with the butt stock removed.

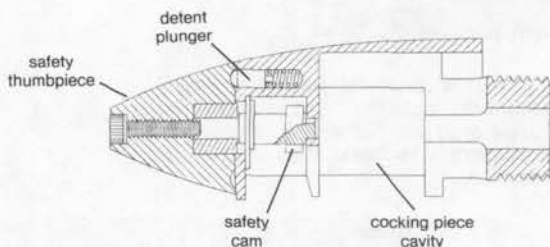
Koon fitted dual safeties. A two-position plunger in the rear web of the trigger guard blocks movement of the trigger piece, with a setscrew in the shoe of the trigger to take up any slack between

Omega III

Dual safety — works independent of each other for convenience and preference, or double safe if desired. Top twist safety located on the rear of the bolt locks the firing pin; the lower large head safety located on the rear of the trigger guard block the trigger. You can use either by themselves, or both as desired.



While Omega III had two safeties, the top one was exceedingly awkward to operate.



Omega III
Sectioned bolt sleeve

the two parts. Once set properly, the dimensional relationship between them is supposed to remain constant due to the all-metal connection between the receiver and trigger guard.

The second safety is a rotating type which engages the firing pin from the rear of the bolt sleeve. Koon intended this upper safety mainly to appease gun writers who frequently criticize trigger safeties. However, it proved so inaccessible as to be virtually useless from a practical standpoint. The thumbpiece was not only buried by a low-mounted scope, but the receiver tang also got in the way, making it very awkward to twist the required 90 degrees.

A small hardened plunger projecting up from the trigger housing helps guide the bolt. Yet, because of a .020 inch diametrical clearance in the receiver, the usual "piston-like" feel associated with most full-diameter bolts is lacking. When drawn fully rearward, the short and undersized square bolt head allowed more than 5/16 inch lateral movement, leaving the bolt very susceptible to cramping at the beginning of the closing stroke.

Hi-Shear Omega III

The Hi-Shear engineers assigned to the Omega rifle weren't commercial arms designers. They didn't even have any particular personal interest in sporting rifles. Even so, it took them little time to recognize that the Omega III needed a lot of revision.

Omega III

They started out by fabricating much smaller casting dies, so that the several hundred Hi-Shear receivers which were made required little more than some cleanup cuts. The "octagon" bolt idea was chucked out, replaced with a round 17-4 PH stainless steel bolt. A few short flats were cut, but just enough to show in the loading port and thus retain an aesthetic illusion to the previous design. The locking lugs were also reoriented 45 degrees so that one of the corners of the bolt head scooped down into the magazine for better cartridge pickup.

All the ratchet and pawl nonsense was cleaned out from inside the magazine. Then an injection-moulded plastic magazine body was substituted for the less precise sheet metal unit, plus a nicer looking gate. At the end, Hi-Shear was even working on an entirely new spool arrangement, patterned more closely after the Mannlicher-Schoenauer system.

To help alleviate the Omega's difficult bolt operation, a low-friction ball bearing attachment was devised between the bolt and bolt sleeve. But this was more than offset by an even shorter striker fall and heavier spring force than Koon had used, as part of a scheme to use stacked belleville washers for the mainspring.

Although Hi-Shear engineers recognized the futility of Koon's "counter-spring" trigger, its extra cost was negligible, and so it was actually a lot easier to retain it than to try to explain its elimination to management. The upper twist-type safety was eliminated, however, giving the bolt sleeve a cleaner contour at the rear. Finally, it was decided to simplify things by reducing the number of stock styles from three to two. Thus it might have been appropriate to also rename the rifle the "Omega II."

Summary

Like Charles Newton, Homer Koon, in his second rifle, tried to correct what he perceived as the mistakes in his initial venture. But it didn't necessarily work out that way, and the Omega III, like the Newton Buffalo, had an even shorter and less successful existence than its predecessor.

What sound ideas went into the Omega rifle were overwhelmed by others that weren't. The "uniblock" receiver was very rigid and well supported in recoil, and the rifle was capable of accurate shooting. The top and bottom guided cocking piece was also a nice idea, but the magazine never worked as intended, the upper safety was essentially nonfunctional and working the bolt was like

Omega III

pulling teeth. The Omega also lacked a cocking indicator and a bolt lock.

The following summarizes the strong and weak points of the Omega III action:

Strong points:

1. Short lock time.
2. Rigid receiver.
3. Strong recoil-lug layout.
4. Shrouded bolt sleeve.

Weak points:

1. Weak extraction and chambering.
2. Stiff bolt operation.
3. Trigger-block lower safety.
4. Non-functional upper safety.
5. Lack of cocking indicator.
6. Bolt stop plunger breakage.
7. Bind-prone bolt.
8. Lack of overtravel stop adjustment in trigger.
9. Metal-sided action, less comfortable to carry than a one-piece stock, particularly in cold weather.

Omega III Dimensions

OPERATING

Extraction: set-back — .11 in.
leverage — 4.5 to 1

Chambering: cam-forward — .09 in.
leverage — 7.5 to 1

Bolt rotation — 47°

Bolt travel — 4.44 in.

Cock-on-opening; .186 in.
mainspring compression
proportioned as follows:

opening — .197 in.
closing — .011 in.

IGNITION

Firing pin travel: at impact — .133 in.
dry-fired — .186 in.

Lock time — 1.9 ms.

Impact velocity — 13.9 ft./sec.
energy — 77.1 in.-oz.
impulse — .93 oz.-sec.

Striker/firing pin hole diameters — .079 in./0.083 in.

RECEIVER

Overall length — 9.25 in.

Length of loading/ejection port — 3.35 in.

Ring cross-section — 1.250 in. (across flats)

Barrel threads — 1-14

Recoil bearing area — 1.00 sq. in.

Guard screws: front — 8x32
rear — 1/4x28

Scope-mounting screws — 6x48

BOLT

Lug shear area — .363 sq. in.

Lug bearing area — .049 sq. in.

Bolt diameter — .870 in.

Lug undercut diameter — .678 in.

Lug diameter — .864 in.

Bolt-face counterbore depth — .117 in.

MAGAZINE

Length — 3.63 in.

Capacity: .30-06 Springfield — 5
7mm Remington Magnum — 4

WEIGHT

Receiver group 29.8 oz.
(includes magazine)

Bolt group..... 16.7 oz.

Floorplate group 6.8 oz.

Total action weight..... 53.3 oz.



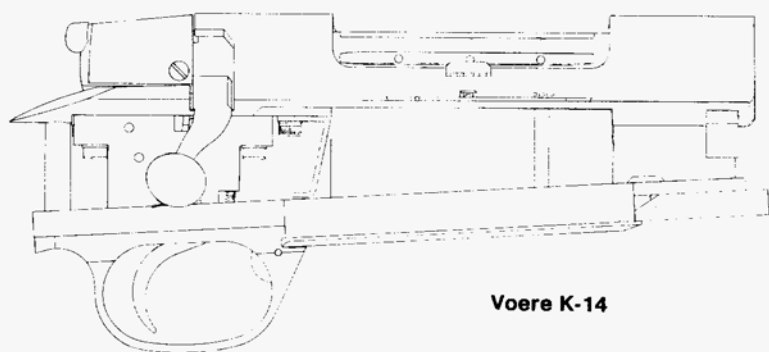
Voere K-14

When "Kleinguenther's Distinctive Firearms" was incorporated in early 1970, this new Texas company found itself marketing a high-powered rifle (the Voere "Shikar" (Chapter 7)) which Bob Kleinguenther personally believed was incapable of long-term commercial success in this country. It thus wasn't long before he began prodding Voere about the possibility of a completely new rifle action, redesigned in such a way as to yield both better performance to the customer and a lower unit production cost for the factory.

This new action began taking shape during a series of meetings in Germany between Kleinguenther and the Voere people, including the two engineers who ended up doing the detailed design work, Ulrich Zedrosser and Josef Kerescher. Kleinguenther was careful to ensure that Voere's rifle this time could fully satisfy the needs of the U.S. sportsman, most particularly including a bolt design which allowed easy operation and a quick follow-up shot. Unnecessary production costs were drastically trimmed by an emphasis on barstock and investment cast parts, thus allowing the rifle to be marketed at a competitive price while still maintaining a reasonable profit margin.

Voere delivered the first prototypes of the new design for Kleinguenther's inspection in 1972. Production began shortly thereafter, and the first U.S. shipments arrived in March 1973. The new rifle was designated the K-14 in this country, the "K" standing for Kleinguenther, and the "14" for his project number. In Europe, the rifle carried Voere's M2145 designation. Kleinguenther soon added "Insta-Fire," an allusion to fast lock time suggested by a shooting friend. This not only livened up the K-14 designation, but helped distinguish it from the previous Voere rifle, which Kleinguenther had briefly given a "K-14" designation also.

Produced between 1973 and 1977, U.S. sales of the K-14 continued until Kleinguenther's inventory was depleted in 1978, at which time



Voere K-14

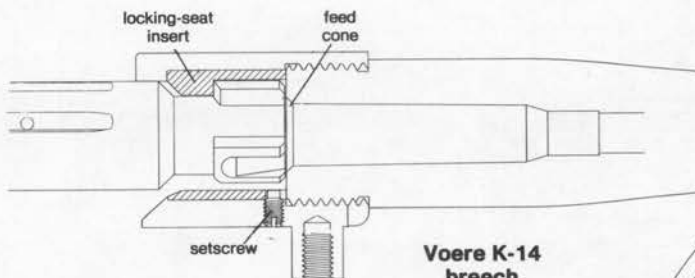
it was superseded by an even later Voere/Kleinguenther redesign, the K-15. Total U.S. sales of the K-14 amounted to approximately seven thousand rifles, plus a relatively modest number of rifles marketed in California under the "Apollo" logo, and in Pennsylvania by Bortmess Arms.

Even though they were shipped as completed and assembled units from West Germany, Kleinguenther rebbed and test-fired each K-14 rifle in his Texas facility prior to shipment to the retailer, enabling him to offer a rather novel accuracy guarantee with each rifle sold.

Between the efforts of Kleinguenther and his counterparts at Voere, a most interesting rifle action evolved. The receiver ring has the same barrel threads as the classic Mauser 98, but also a special high-alloy insert to breech the bolt, in place of conventional integral locking seats. Fabricated from barstock, and with a welded-on recoil lug, the receiver can remain soft and relatively non-complex due to this insert. The barrel is coned for smooth feed, while the opposing bolt face has a shallow counterbore which came in a single diameter, regardless of cartridge. Inside the bolt, dual-opposed cocking cams ease operating requirements, while a "floating" striker head forward of the main firing pin eliminates binding during firing. Adjustments of the firing pin permit the shooter to choose between two lock times. The trigger guard and floorplate form a unique single unit which swings down to uncover a detachable box magazine system.

The K-14 barrel has a .060 inch deep cone to facilitate cartridge feed. Thus, despite a close-fitting bolt with a shallow (.101 inch) counterbore in its face, *effective* cartridge-head protrusion is on the maximum side. For this reason it is particularly important to have close dimensional control over the breeching process. This is

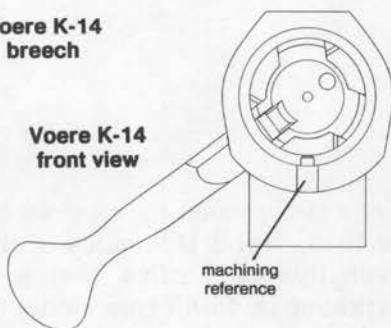
Voere K-14



**Voere K-14
breech**

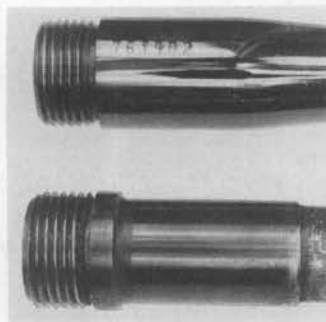


The .060 inch deep cone at rear of barrel aids cartridge feed, but also increases the effective rearward protrusion of the cartridge head.



**Voere K-14
front view**

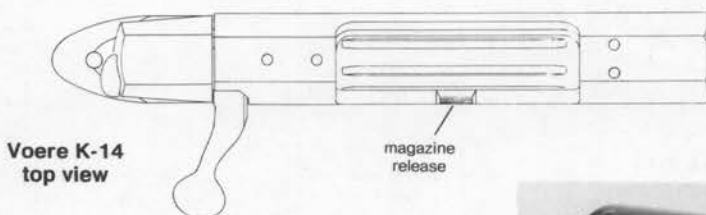
Barrel tenon of K-14 (top) is essentially identical to that of Mauser Model 98 (bottom).



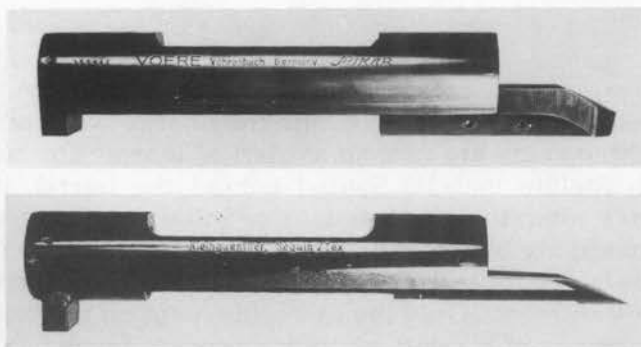
ensured at Voere by the fact that they use a single internal referencing system. The receiver and barrel are dimensioned so that rather than making primary contact out at the front face of the receiver, the barrel seats directly against an internal shoulder inside the receiver ring adjacent to the bolt face, as in the Mauser Model 98.

Gas escaping from the breech is handled in a basically similar manner to the Shikar, except the K-14 has slightly smaller ports along the side of the bolt body, on the theory that these will limit the amount of dirt that could enter and possibly jam the firing pin assembly. A rearward-driven firing pin is blocked by the rear wall of the bolt sleeve, perhaps fortunate in view of the fact that only a rather thin washer anchors it to the mainspring.

Voere K-14



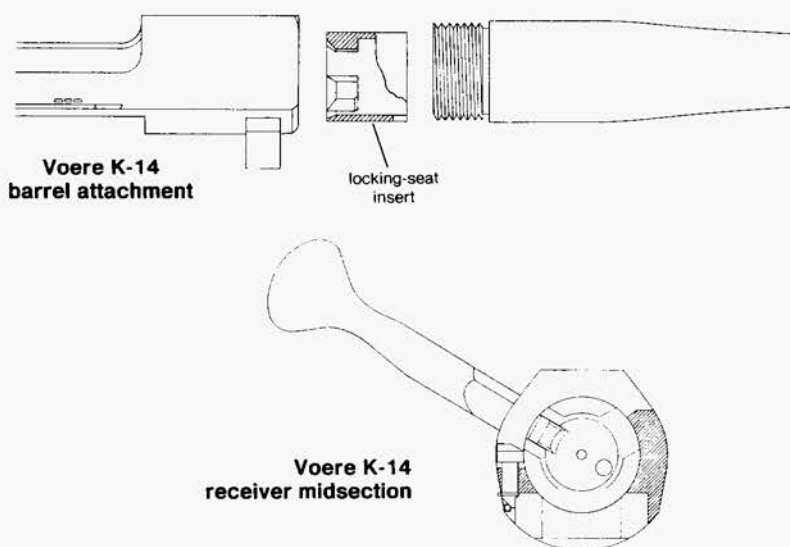
Technique used to weld recoil lug in place under the receiver ring leaves a rather messy looking job. Small setscrew immediately behind recoil lug prevents rotation of locking-seat insert.



While very similar above the stock line, K-14 receiver (below) is much more easily manufactured than earlier all-milled Shikar receiver (above).

When bedded into the stock, the K-14 receiver resembles the earlier Shikar, with even identical scope-mount patterns. Underneath the stock line, however, basic differences in fabrication are apparent. In contrast to the extensive milling operations required to carve out the Shikar receiver, cutting the K-14 receiver from barstock was largely a simple turning operation. Seamless tubing was even used for the first several lots of rifles, before Voere discovered that solid blanks better suited their machining setups. Kleinguenther strongly favored a Remington-like recoil bracket clamped in place by the barrel, but Germans stubbornly regard that approach as substandard. Voere thus welded the recoil lug to the bottom of the receiver instead. At the back, the bottom of the receiver is simply milled flat, then drilled and tapped for attachment of the trigger.

Voere K-14

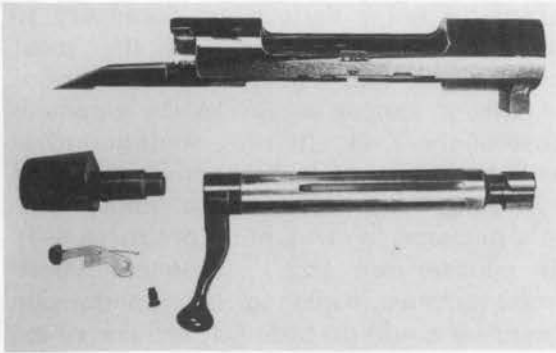


Rather than being machined directly into the interior walls of the receiver, the locking seats are formed as part of a separate insert ring made from Stellite metal. Seated behind the barrel, it is pressed into place after the receiver is blued, thus avoiding any possibility of entrapping bluing salts in this area. This insert ring greatly simplifies not only the internal geometry of the receiver, but also its heat treatment. Only the extraction cam on the bridge is hardened, by means of a relatively quick process involving the use of a small induction coil and a liquid-jet quench.

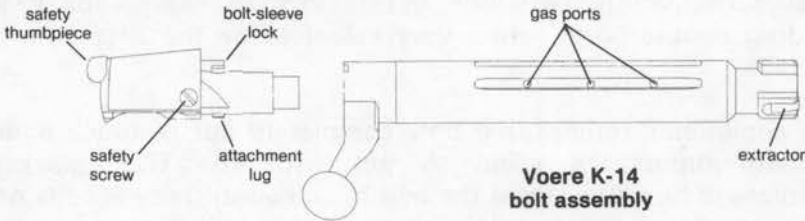
Despite the general lack of strength requirements which resulted for the receiver, Kleinguenther nevertheless considered it highly desirable to retain a reasonable overall hardness, to ensure smooth bolt operation and resistance to gouging and scratching. He was no more successful here than with his ideas on the best type of recoil-lug arrangement, however, and all the production receivers were soft.

The finish-machined K-14 receiver has relatively little metal left between the ring and the bridge. The left receiver rail is small, while the right side is sliced almost in half at one point for a special magazine release system. It may seem incongruous for a bolt action rifle without a "rigid" receiver to be marketed with an accuracy guarantee. This was possible, however, because Kleinguenther bedded the finished rifle in such a way that the receiver midsection didn't really need to support the barrel in the classic "cantilever" manner normally associated with target rifles. A

Voere K-14



Formation of both the receiver and bolt entails welding. "Rail" on right side of receiver houses magazine release mechanism.



barrel pressure point near the tip of the forearm combines with the major bedding area around the recoil lug, and a solid tie-down around the rear guard screw, to form a unique three-point system which essentially ignores the receiver's midsection.

The K-14 used the same diameter bolt as the magnum version of the Shikar rifle. Some of the bolts in the first shipments of rifles had separate bolt heads; however, most of the production rifles were fitted with a one-piece bolt body. The investment-cast bolt handle has a circumferential collar at its base for attachment to the rear of the bolt body. After being pressed in place, a hole through this collar is filled with weld metal to form a permanent assembly.

There is considerably less "fluting" on the exterior circumference of the K-14 bolt than was applied to the Shikar. Despite his many years with Weatherby, Kleinguenther had little use for bolt flutes, considering them essentially cosmetic gimmicks, which if anything just tended to catch on cartridges in the magazine box and scrape them up. He thus favored eliminating fluting entirely from the K-14 bolt, with a view toward trimming production costs. Voere did at least compromise partially on this point. They ended up eliminating half the flutes, retaining only the three on the top of the bolt. While these are essentially nonfunctional, they do allow the rifle to retain the "Weatherby" look while hanging on a gun rack or sitting in a gunshop display case.

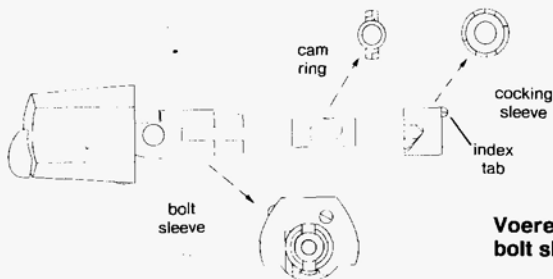
Voere K-14

In the Shikar rifle, different diameter bolts were necessary to accommodate different cartridges, possibly one of the most colossally inefficient approaches ever taken in the manufacture of a bolt action rifle. Voere swung almost as far in the opposite direction during manufacture of the K-14. In 1975, Kleinguenther received his usual mixed-caliber shipment of K-14 rifles, but with all magnum bolts. Upon phoning West Germany to report their "error," he was informed of a decision to streamline production by standardizing on a single counterbore size. It seems Voere considered the bolt-face counterbore walls to be functionally superfluous. While Kleinguenther could do little but sell the rifles, he did subsequently persuade the factory to change back to individual counterbores when they retooled for the K-15 rifle in early 1978.

It is sometimes remarkable how completely out of touch some European gunmakers seem to get with the U.S. market. Regardless of how functional the bolt head counterbore is or is not (and an argument can certainly be made that it is functional), the real point is that the U.S. shooter has been educated to consider it important, and thus such a modification simply isn't overwhelmingly astute on any count.

The K-14 bolt sleeve outwardly resembles that used in the Shikar rifle, and has essentially the same safety mechanism inside. Its attachment to the rear of the bolt is different, however, using a much smaller lug than before. Also, it has a long two-diameter nose which extends unusually deep into the bolt interior, to not only support the mainspring but also function as part of a special cocking system.

A small plunger fitted into its front rim helps control rotation of the bolt sleeve once it is attached. When the bolt is lifted and started back, this plunger springs forward to lock the bolt and bolt sleeve together. On closing, contact with the bridge decouples the plunger just prior to bolt turndown. This special lock, similar to

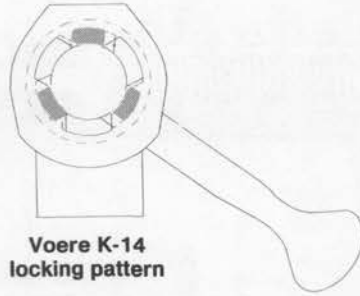


**Voere K-14
bolt sleeve/cocking system**

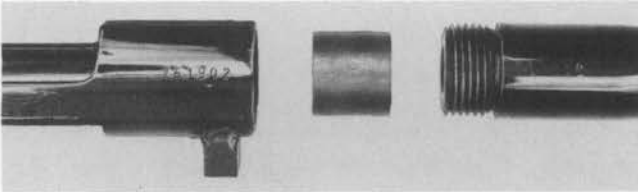
Voere K-14



Locking seats in K-14 are formed with precision as part of a separate high-alloy locking insert.



Voere K-14
locking pattern



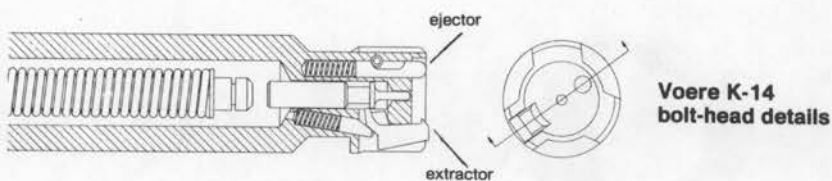
The locking seat insert is clamped in place by the rear face of the barrel tenon.

that used in the Mauser 98 rifle, is necessary because, while the K-14 does have a "holding" notch (two in fact) for the cocked firing pin, they are left very shallow intentionally to prevent interference with a smooth bolt closure.

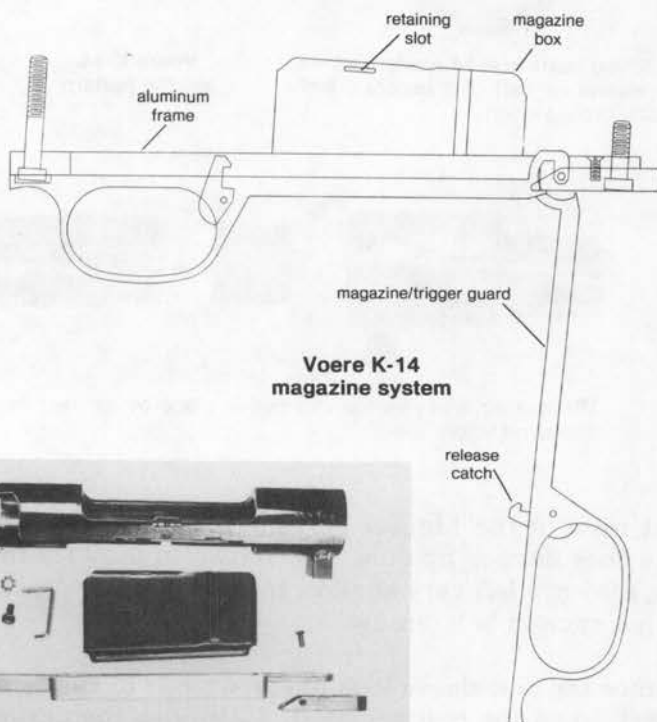
Since the bolt-sleeve lock plunger tends to spring or float the bolt sleeve when the bolt is closed, it also has the desirable secondary effect of cushioning the impact of the parts when the rifle is "dry-fired."

While the bolt uses three locking lugs machined integral with its head, as noted earlier the recesses into which they seat to breech the rifle are not cut directly into the receiver ring. One of Paul Mauser's most significant contributions to bolt action design was an arrangement which guaranteed that the locking lugs were fully engaged in the receiver whenever the bolt was closed to fire, something not necessarily true of other systems of the time, particularly those with separate bolt heads. Recently several new bolt actions, among them the K-14, seem to have reopened the issue. With this Voere rifle, it is the locking seats, rather than the bolt head, that could conceivably be out of phase when a cartridge is fired. Thus Voere had to be particularly careful about anchoring the locking-seat insert, and a special setscrew threads up from the bottom of the receiver ring for this purpose.

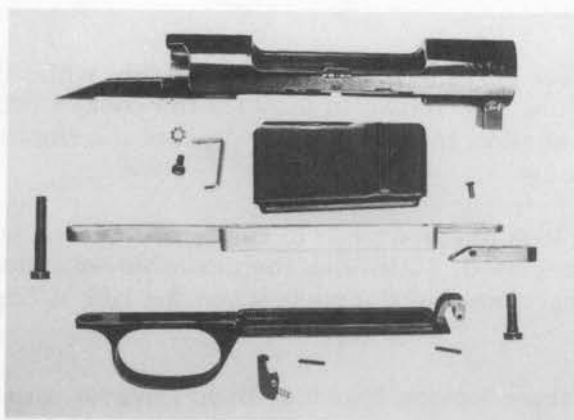
Voere K-14



**Voere K-14
bolt-head details**

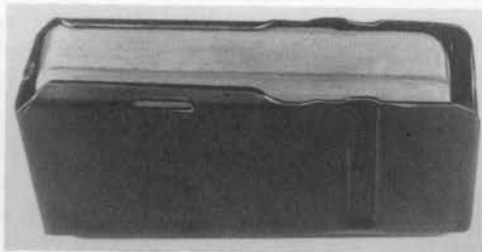


**Voere K-14
magazine system**



Weight and complexity of K-14 magazine system partially offsets its functional advantages.

Inside the self-contained magazine box is a solid brass cartridge follower. While Voere claims that brass prevents marking cartridges, it also certainly adds unnecessary weight, and like the use of Stellite for the locking-seat insert, marketing appeal was probably a stronger factor behind such an unusual material choice.



The extractor is a small L-shaped investment casting. Pivoting near its middle, a tail at its back end reaches into the bolt interior to position the firing pin, a novel "extra" function examined in detail later. On the opposite side of the bolt face, a conventional spring-loaded pin does the ejecting.

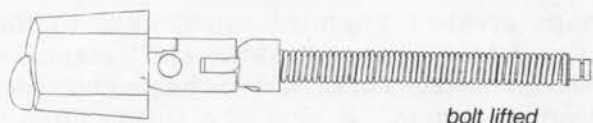
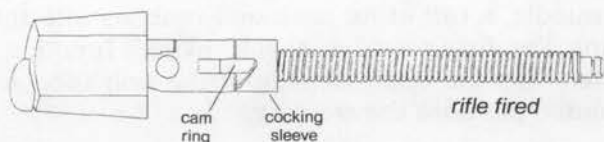
Of perhaps greatest practical significance to the majority of users of the K-14 rifle is a "hidden clip" magazine, essentially boasting the advantages of both detachable clip types and a fixed-box, top-loading system. A bent-wire spring fitted into the right receiver rail locks a detachable double-column magazine box in position. Underneath, a rigid die-cast aluminum frame spans the two guard screws to support a hinged trigger guard and floorplate which was fabricated into a single unit. This arrangement provides the same advantages insofar as appearance, security and protection from the elements as in any conventional fixed-box magazine rifle. Yet when it is desired to empty the magazine, or replace it with another, a release button inside the trigger bow allows the entire assembly to swing down and expose the underside of the magazine.

A true one-handed operation, it is faster and easier than unlatching a conventional hinged floorplate. And once the trigger guard unit is lowered, another button on the right wall of the receiver drops the exposed magazine box down. Also, the trigger adjustments become fully accessible without having to disturb any guard screws.

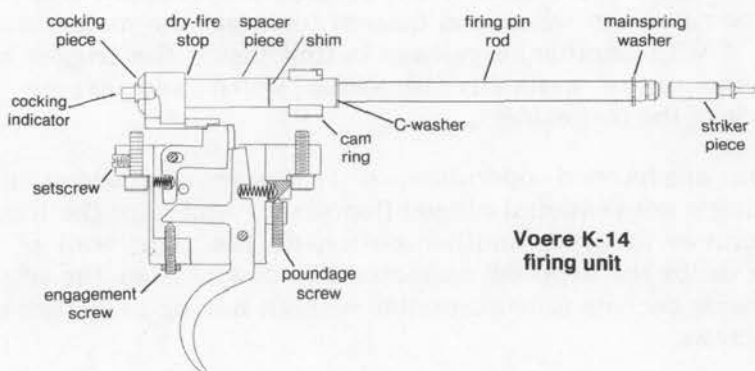
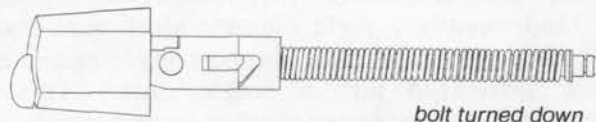
The cocking system, the singular aspect that virtually wrecked the Shikar as a practical firearm, underwent enormous improvement for the K-14 rifle. Voere developed a novel arrangement (German Patent 2,238,120, issued February 14, 1974 (U. Zedrosser and J. Kerescher)) for balancing the cocking cam forces about the firing pin axis. Similar solutions have occasionally been applied to other rifles, including the Texas Magnum and the Steyr-Mannlicher SL series. In the K-14, however, not only are the cams balanced radially, they are also moved forward toward the middle of the firing pin.

An investment cast "cocking sleeve," containing dual-opposed cocking notches, fits a counterbore in the rear of the bolt. Entrapped linearly by the bolt sleeve nose upon which it journals, it is indexed to turn with the bolt by a tab which fits a notch in the bottom of the bolt counterbore. While thus functioning like integral cam notches cut deep inside the bolt interior, this sleeve has much better precision and surface finish than would be possible by trying to actually mill the notches into such an

Voere K-14

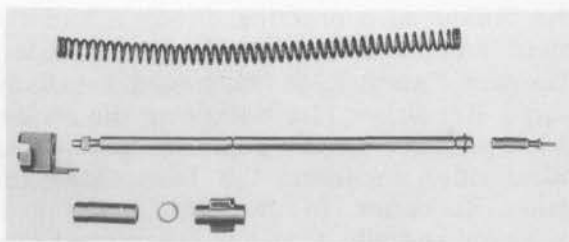


Voere K-14 cocking system



Voere K-14 firing unit

K-14 firing pin system comprises an assemblage of small precision parts, including a unique "floating" front striker piece. Dual cams on the small cam ring (bottom) gave a smoother cocking action than would have been possible with a single conventionally located cam.



inaccessible location. Behind the cocking sleeve, a second small investment-cast part carries the corresponding cocking cams. This "cam ring" is free to move axially, but is prevented from rotating by vertical slots in the nose of the non-turning bolt sleeve.

The notches in the cocking sleeve drive the non-turning cam ring rearward as the bolt is lifted. Transmitted through a spacer to the cocking piece, this motion compresses the mainspring and cocks

the action. At full lift, the cams rest in shallow holding notches on the rim of the cocking sleeve.

This thoroughly balanced geometry, combined with working parts which are very precise, smooth and easy fitting, allow cocking a powerful mainspring with an entirely reasonable bolt-lift effort. Lifting the K-14 bolt demands but seven pounds — less than one-third the effort required for the previous Shikar rifle.

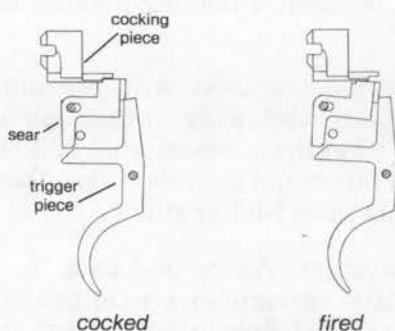
There is an equally novel ignition system. Advertised as a "two-piece firing pin," in reality it bears little resemblance to either the kind of two-piece system found in the old Springfield M1903, or those in many single-shot rifles. The M1903's two-phase impact failed to deliver mainspring energy to the primer as a single solid blow, while in the classic single-shot rifle, an "inertial" firing pin proceeds forward independent of the mainspring after being struck by a separate hammer.

In the K-14, a small precision "striker piece," barely an inch long and weighing less than a tenth of an ounce, literally floats in the bolt head. Rather than being spring-biased, as in many single-shot rifles and revolvers, it is positioned relative to the primer by way of the extractor. Prior to bolt closure, the inward-projecting tail of the extractor allows the striker piece to recess a few thousandths of an inch. When the bolt closes, the pivotal displacement of the extractor caused by the head of the cartridge eases the striker tip forward until it is just flush with the bolt face. It is thus already virtually in contact with the primer when struck by the spring-driven firing pin rod, allowing for all practical purposes an instant and undiminished transmittal of the impact, without any decoupling or cushioning action to weaken the ignition process.

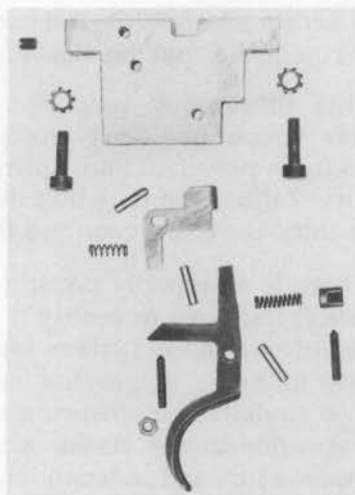
While it might seem obvious that slicing off part of the firing pin and prepositioning it against the primer would shorten lock time, the gain here was actually very slight, something less than .05 millisecond. The real goal of this "floating striker" was to form a self-aligning firing pin assembly which avoided the internal binding possible with a close fitting one-piece unit.

The firing pin rod is grooved at several places for C-washers, then machined out at the rear to form a pair of attachment lugs. The cocking piece is entrapped back against these lugs by a stacked assembly consisting of a spacer piece, cam ring, and C-washer. Some looseness caused erratic ignition in the prototype versions of the K-14 rifle, and so in putting together each production rifle a selected shim of proper thickness was added to the stack to remove free play, and thus avoid any danger of a Springfield-like cushioning of the striker blow.

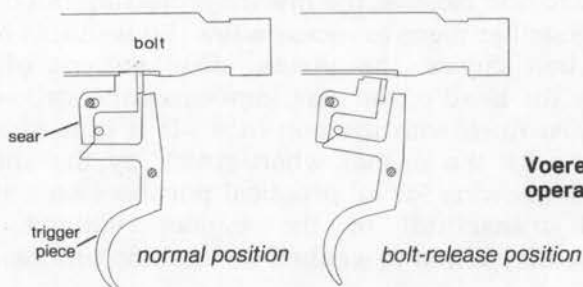
Voere K-14



Voere K-14
operation of trigger



Aluminum trigger housing, attached to receiver by two small hex-drive bolts, can be slid back and forth slightly to limit range of poundage adjustment. Oversize hole in sear allows it to "float" on its pivot pin as in some target triggers, giving a more uniform engagement with the trigger piece below.



Voere K-14
operation of bolt stop

Two of the grooves cut in the firing pin rod are for the mainspring washer. Spaced exactly four millimeters apart, these grooves make it possible to choose between two mainspring settings. Another rather novel Voere idea, this system is based on the assumption that a shooter might choose to sacrifice some mainspring power for a little easier bolt opening. Moving the washer to the front groove relieves about one and a half pounds of compression, leaving a thirty-pound preload. Kleinguenther didn't think an awful lot of the scheme, however, and all rifles shipped from his Texas facility had the washer in the rear groove, giving full mainspring compression and maximum ignition power.

The rear of the firing pin rod serves as a rudimentary cocking indicator. Prior to firing, it lies flush with a hole in the rear wall of the bolt sleeve, recessing inside upon firing.

Voere K-14

The trigger is a modern override type. A die-cast aluminum housing, clamped beneath the receiver by two screws, contains an investment cast trigger piece and sear. The sear, which not only controls the firing pin but also movement of the bolt, is drawn down for bolt removal by overpull of the trigger. Thus in its normal mode, little useful control of trigger overtravel is possible. There are adjustments for sear engagement and poundage, however, each fully accessible when the trigger guard is unlatched.

Because poundage in K-14 prototype rifles could be set lower than Kleinguenther was really comfortable with, he helped devise a system to ensure a baseline pull of not less than two pounds. The trigger housing has two vertical mounting holes, each of which is oval shaped to allow a limited fore and aft shift when the attachment screws are loosened. After Kleinguenther sets the poundage screw for a minimum pull as part of his tuning up procedure, the housing is slid forward until the beveled carrier for the trigger spring contacts the head of the front attachment screw. The screws are then tightened, and a rear setscrew is bottomed out so the housing would return to the same position if ever removed. The trigger is thereafter adjustable only in the direction of a heavier pull.

The head of the sear, engaging a close-fitting groove along the underside of the bolt, serves as a bolt guide as well as a bolt stop. Because it pivots on an oblong hole, the sear can yield slightly against its spring in stopping the bolt, thus minimizing stress on its pivot pin. Pulling the trigger completely back tips the sear clockwise, lowering its nose for bolt removal.

Summary

The K-14 was a big improvement over the Shikar, both from the viewpoint of use and manufacture. The bolt operates easily enough to be entirely practical in both the field and on the target range. Detail redesign of the parts, and changes in many of the processes used to make them, reduced manufacturing time for the action to roughly half of what had previously been required.

From an engineering standpoint, the K-14 is loaded with novel approaches. Some, such as the cocking arrangement, are obvious improvements. With others, like the separate locking-seat insert and the detached striker head, the net gain is less clear. The hidden clip magazine system is very functional, but contributes considerable extra weight to the action, helping make it some eight ounces heavier than the Shikar.

Voere K-14

The following summarizes the strong and weak points of the K-14 action:

Strong points:

1. Fast lock time.
2. Direct-acting safety.
3. Balanced cocking cams.
4. Convenient and reliable magazine system.
5. Good access to trigger.

Weak points:

1. Sear bolt stop.
2. Weak extraction and chambering cams.
3. Lack of overtravel control in trigger.
4. Soft receiver.
5. Standardized bolt counterbore diameter.

Voere K-14 Dimensions

OPERATING

Extraction: set-back — .06 in.
leverage — 8 to 1

Chambering: cam-forward — .05 in.
leverage — 12 to 1

Bolt rotation — 67.5°

Bolt travel — 4.81 in.

Cock-on-opening; .175 in.
mainspring compression
proportioned as follows:

opening — .190 in.
closing — .015 in.

IGNITION

Firing pin travel: at impact — .120 in.
dry-fired — .175 in.

	rear groove	front groove
Lock time (ms.)	2.0	2.1
Impact velocity (ft./sec.)	11.7	11.4
energy (in.-oz.)	59.5	56.4
impulse (oz.-sec.)	0.85	0.82

Striker/firing pin hole diameters — .065 in./ .073 in.

RECEIVER

Overall length — 9.11 in.

Length of loading/ejection port — 3.39 in.

Ring diameter — 1.265 in.

Barrel threads — 1.1 - 12

Recoil-lug bearing area — .35 sq. in.

Guard screws (metric) — M6x1

Scope mounting screws (metric) — 3.75x.7

BOLT

Lug shear area — .511 sq. in.

Lug bearing area — .086 sq. in.

Bolt diameter — .845 in.

Lug undercut diameter — .612 in.

Lug diameter — .845 in.

Bolt-face counterbore depth — .101 in.

MAGAZINE

Length — 3.38 in.

Capacity: .30-06 Springfield — 5
7mm Remington Magnum — 3

WEIGHT

Receiver group 19.2 oz.

Bolt group..... 17.6 oz.

Magazine/floorplate group 12.8 oz.

Total action weight 49.6 oz.

Colt Sauer

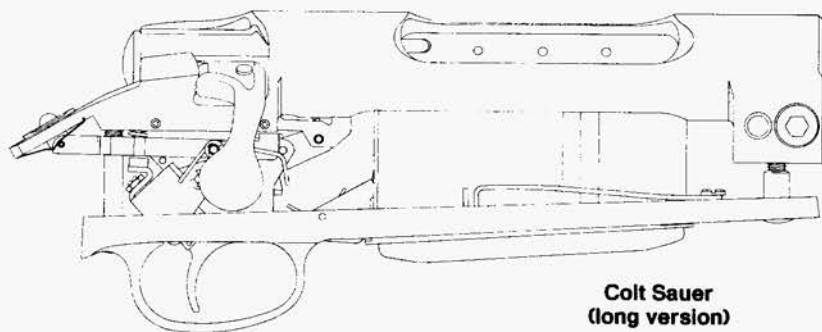


J. P. Sauer & Sohn GmbH, of Eckernforde, West Germany, manufactured the Weatherby Mark V high power rifle from very shortly after its inception in 1958 until 1972. While most of these rifles were marketed by Weatherby, a "Model Europa" variation was also distributed by Sauer throughout Europe. In transferring production to Japan, Weatherby pulled out of its West German deal entirely, foreclosing even the opportunity for Sauer to continue with a small-scale production of their version of the rifle for the European market. Yet, Sauer was equally determined to remain in the rifle business, and well before receiving Weatherby's official eighteen-month termination notice, the firm set out to develop its own replacement.

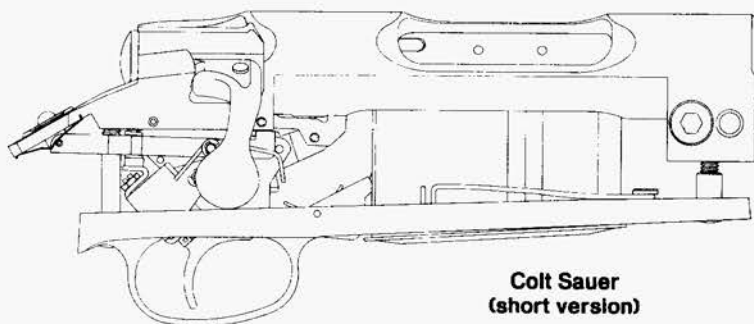
Under Sauer's chief engineer Manfred Birkenhagen, the action for the new rifle began taking form along very close lines to the Weatherby. The first layout, in fact, used a one-piece bolt with nine locking lugs at its head, the main difference simply being that the lugs were on an interrupted acme thread to give smoother operation than had ever been possible in the Weatherby rifle.

Meanwhile, market surveys were persuading Sauer's management that they could do better with something more unique in a rifle mechanism. Heinz Bielfeldt, hired in 1970 as Birkenhagen's assistant, proved ideal for this purpose. Lacking the constraints of a formal background or apprenticeship in firearms design, and gifted with a fertile imagination, he was principally responsible for the very unusual directions that development of the new rifle subsequently took. Thus, despite a few perhaps inescapable overall resemblances to the Mark V, Sauer ended up with one of the most novel actions ever used in a bolt rifle.

Colt Firearms of Hartford, Connecticut, became involved in the project relatively early. Recognizing the economic futility of tooling up and manufacturing without a good marketing network



**Colt Sauer
(long version)**



**Colt Sauer
(short version)**

in the United States, Sauer visited several arms companies in this country seeking a partner for the rifle project. Colt, in turn, was at the time quite eager to expand beyond the handgun business, and was in fact already looking over some Japanese shotguns.

Except for insisting on cammed locking lugs, Colt's influence was focused mainly on the "cosmetic" progress of the rifle. Colt officials considered the first prototypes they examined to be overly large and "teutonic" looking, and probably their most important suggestion was to "sculpture" the exterior of the receiver, transforming a boxy action into one of the best looking and streamlined ever used in a high power rifle.

Colt negotiated a formal contract with Sauer in November 1971, agreeing to import a given quantity of rifles each year in designated calibers. The first small shipment of "Colt Sauer" rifles reached this country by spring 1972, with enough arriving by that fall to supply the New Mexico hunting trip at which Colt officially introduced the rifle to a select cadre of gun writers.

Colt's rifle plans originally encompassed a second line of

Colt Sauer

"volume" rifles to be introduced once the rather premium-priced Colt Sauer rifle was firmly established in the marketplace. Two options for this second rifle were considered.

The first was based on the importation of a slightly restyled version of the Mauser Model 3000 (Chapter 11). Colt's marketing surveys, however, found limited enthusiasm for that approach. More promising was the development of a downgraded version of Sauer's design, to be manufactured either at Hartford or at Eckernforde, depending on how the numbers came out. Yet, despite considerable engineering effort, Colt failed to develop an economy model which retained sufficient reliability, and equally important, "identity" with the Colt Sauer. The basic action mechanism was just too complex to yield much in the way of cost cutting without also seriously jeopardizing performance, and thus the original Colt Sauer rifle has ended up going it alone for the more than ten years of its existence.

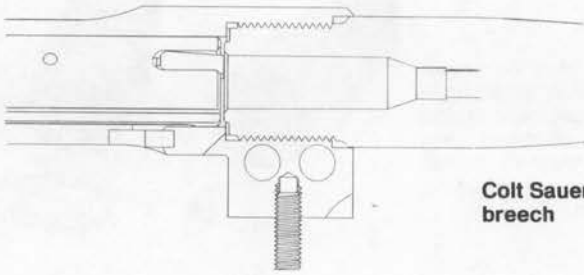
The rifles were originally available only on a long action, chambered for .300 Winchester Magnum, 7mm Remington Magnum, .30-06, .270 Winchester and .25-06 Remington. In 1974, a shorter action added the .22-250 Remington, .243 Winchester and .308 Winchester.

Seven patents were issued to Sauer during the development of this novel action mechanism, which boasted among other things, a multipiece bolt locked by rear flip-out lugs, a forged and "sculptured" receiver slit open underneath to clamp around a "variable-headspace" barrel, a firing pin actuated by dual main-springs, and two special exterior buttons to provide functions found in none of the rifle's competitors.

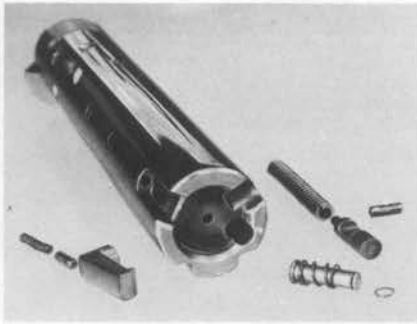
<i>Patent</i>	<i>Inventor</i>	<i>Subject</i>
3,707,795	H. Bielfeldt	locking system
3,707,796	H. Bielfeldt	safety
3,731,418	M. Birkenhagen	barrel attachment
3,782,022	Bielfeldt/Birkenhagen	bolt release
3,835,566	H. Bielfeldt	locking system
3,834,053	H. Bielfeldt	barrel headspacing
2,260,171 (German)	H. Bielfeldt	safety

Being a rear-locked action, the Colt Sauer should, by nature, be strong breeched. Indeed, Colt advertisements emphasize this point. Without locking recesses, the bore of the receiver ring can

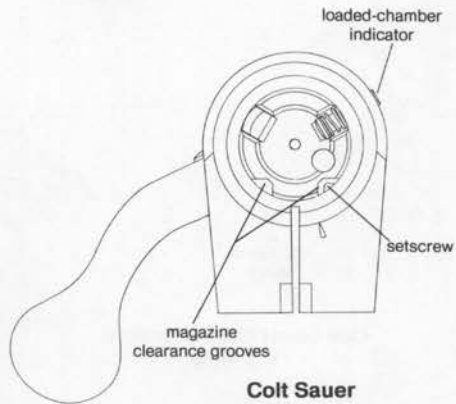
Colt Sauer



Colt Sauer
breech



Several things prevent Sauer's bolt head from functioning as a solid breech plug. Clockwise from bottom are two deep grooves for magazine clearance, extractor cutout, slot for loaded-chamber indicator plunger, and ejector pin.



Colt Sauer
front view

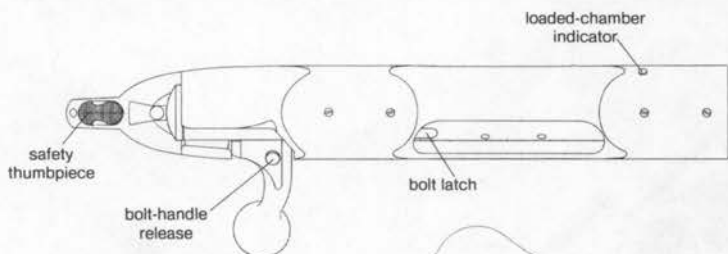
fully encircle the bolt. Sauer's bolt head, however, doesn't cooperate. It is, in fact, a rather perforated affair. Besides an extractor slot, a more or less expected compromise, its walls are interrupted on the opposite side for a special loaded-chamber indicator. Between these two openings, the clearance for the ejector pin, and a bevel on the inside lip of the counterbore, barely one-third of the inner rim remains effectively intact to shroud the cartridge head. The bolt head is even violated on its outer circumference by two grooves cut to clear the magazine lips.

Thus, although there is only a basic .005 inch boltway clearance, the breeching potential of a close-fitting pistonlike bolt is effectively lost anyway. Special gas handling provisions are pretty much limited to three gas ports along the side of the bolt (two in the short version) and a shrouded bolt sleeve. There are no holes in the receiver ring, mainly because the barrel seats too deeply to allow a reasonable looking gas port location.

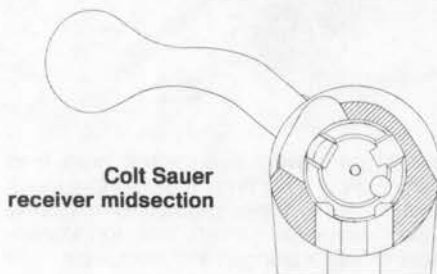
Like the Savage 110, Sauer's barrels are pre-chambered. Rather

Colt Sauer

Colt Sauer barrels (7mm Remington Mag., left, and .243 Winchester, right) have small feed cone cut into chamber entrance. They are shimmed away from bolt head with washers (front), one of which is shown with a lamination partially peeled off.



**Colt Sauer (short version)
top view**



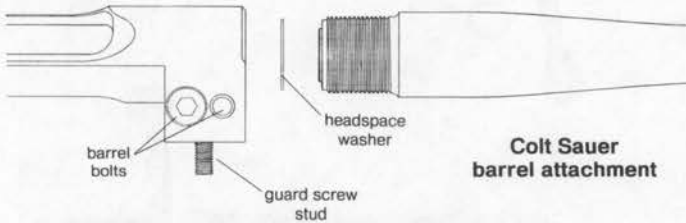
**Colt Sauer
receiver midsection**

than shouldering at the face of the receiver, they contact against an interior washer. Consisting of .1 mm (.004 inch) laminations, Sauer uses these washers to control headspace within approximately $\pm .002$ inch at assembly. Yet a process of installing a barrel, checking headspace, peeling off or adding laminations, then installing the barrel again to recheck headspace, seems strangely slow and inefficient in a modern production operation. It can also tend to treat the final position of the barrel as a by-product. The two samples examined had "breech gaps" of .026 and .031 inch, somewhat on the high side compared to many other modern high-power bolt actions.

The Colt Sauer receiver is a heavy and intricately machined part. Starting as a forged billet of chrome-moly steel, it finishes up a hefty 24.1 ounces (22.7 ounces in the short version). While it has a smaller outside diameter and larger boltway passage than most conventional Mauser-type receivers, the lack of locking recesses leaves a lot of extra metal in the receiver ring. A full-diameter bridge, and minimum-sized magazine and loading ports, also



Receiver ring clamps around barrel by means of two massive cross bolts. Front guard-screw stud limits compression, while laminated washer controls headspace.



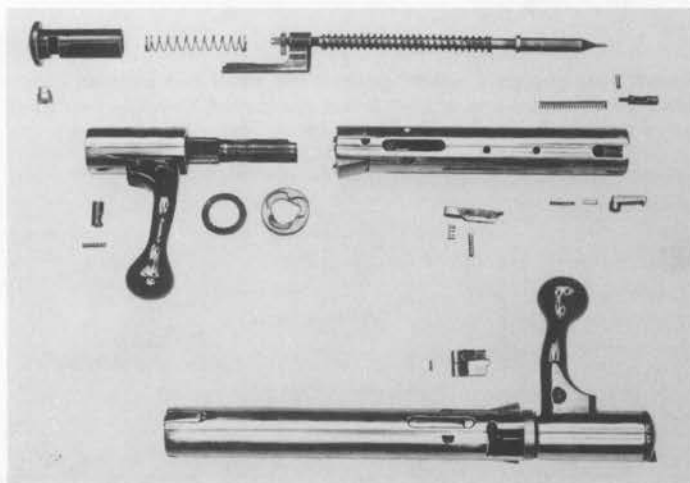
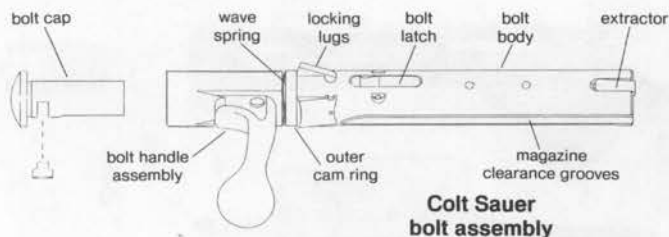
stemming from the rifle's rear locking system, further boost receiver weight. Finally, there is a heavy block-like structure underneath each end of the receiver.

The threads inside the receiver ring are formed oversize to permit the barrel to be readily turned in and out by hand. A lengthwise slit underneath the receiver ring allows two massive cross bolts to then draw it tight around the barrel. This arrangement facilitated the unique "washer" headspace system, but other possibilities occurred to Sauer also. Removal and replacement of barrels without recourse to vices and major wrenches would make it possible to quickly and easily switch calibers, even in the field, or simply remove a barrel for ease of transporting. The precision and repeatability of the system supposedly reduced the need to rezero the rifle in comparison to previous takedown systems.

Colt chose not to market a quick takedown rifle, however. Considering the course of product liability settlements in recent years, this decision not to encourage customers to change barrels and set headspace themselves perhaps proved to be extremely prudent.

Yet another aspect of this barrel joint was its strength. Tests at

Colt Sauer

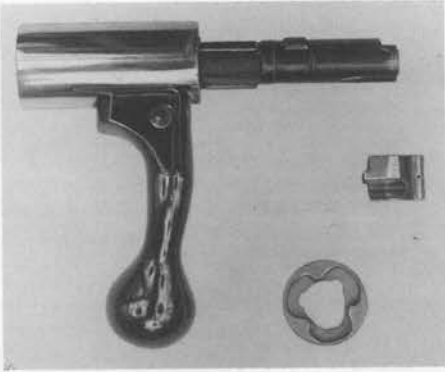


Complexity of Colt Sauer bolt obviously precludes "field" stripping. The three rear lugs fit knuckle joints in the bolt body. A tool company outside West Germany assisted Sauer in developing the technique necessary to cut these precision cavities.

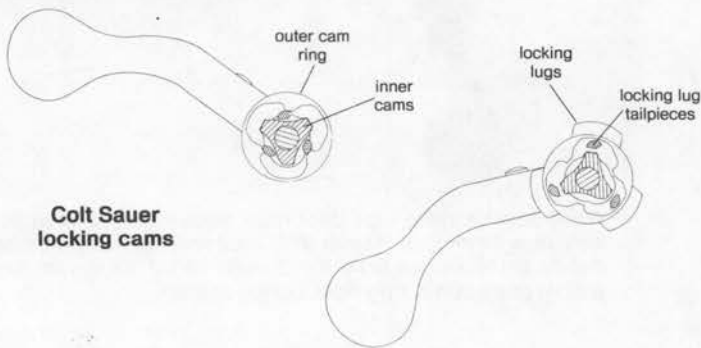
Sauer indicated that it made up more solidly than was possible with conventional threads, which contact only on one side of each thread flank. The radial compression on the barrel shank was also considered beneficial. It was these aspects upon which Colt's marketing efforts focused, claiming in advertisements that the clamped threads make the receiver and barrel "act as one solid piece of steel."

The chrome-vanadium bolt comprises three major parts: a non-rotating body which slides back and forth in the receiver, a forged bolt handle assembly, and a non-rotating bolt cap. The bolt body is guided and keyed against rotation by a latch underneath the receiver, while the rear cap is prevented from turning by the firing pin. After the bolt handle is lifted, and drawn a short distance rearward, a small latch locks it to the bolt body, preventing inadvertent rotation between the two.

Colt Sauer



Cams both spread and retract Sauer's locking lugs. Ring-like cam (bottom) is a relatively brittle and low-strength powder-metal part. Tapping the bolt open to extract a stubborn case can in fact fracture this ring, rendering the rifle unserviceable.

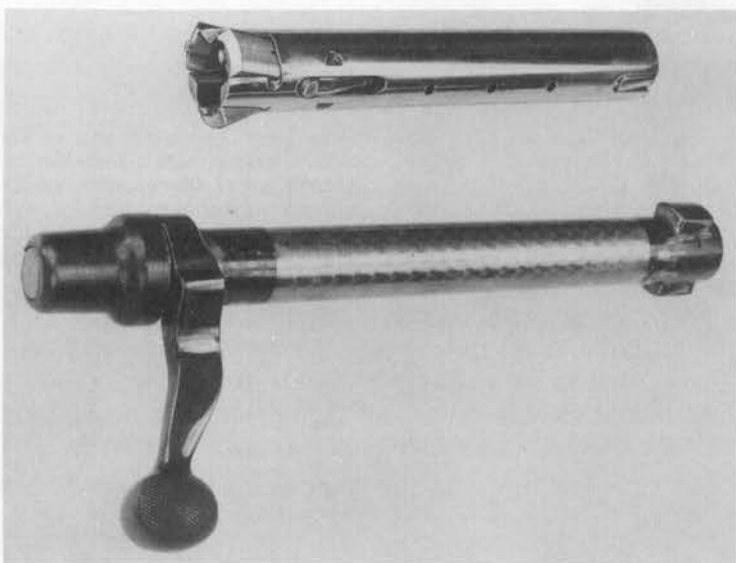


Instead of conventional fixed locking lugs, Bielfeldt experimented with a succession of retractable types. He initially applied a toggle system. When this didn't prove particularly useful, he went to simpler pivoting lugs, first nine at the bolt head, then three at the rear of the bolt. Pivoting lugs actually have a long history in auto-loading weapons, speeding cycle times by eliminating the need for the bolt to rotate during locking. These rifles utilize relative axial displacement within the bolt to position the lugs, and this was Bielfeldt's original approach also. His first patent details a multi-piece "telescoping" bolt, where the rear section wedges underneath to spread three pivoting locking lugs outward. Tiny springs retract them inward on bolt opening.

Considerable testing and evaluation revealed several problems for Sauer with this arrangement. Most obvious, the axial free play between the bolt parts increased the overall length of the action to an undesirable extent. But worse, the small retraction springs proved susceptible to failure, particularly if the rifle was subjected to dirt or extreme cold. Also, Colt's engineers were less than thrilled with the idea of spring-powered lugs.

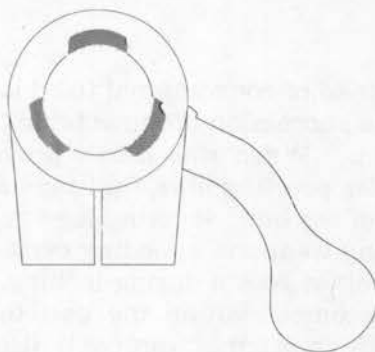
Thus, a second system featuring the non-rotating bolt body and

Colt Sauer



While Sauer's three lugs (top) have greater locking area than two lugs of a Remington Model 700 (bottom), their location approximately 5-1/4 inches from the breech (4-1/2 inches in the short action) precludes a truly rigid locking system.

Colt Sauer
locking pattern



dual rotary cams was developed and patented (No. 3,835,566) as a substitute. Relative rotation between the bolt and bolt handle positions the three locking lugs by way of inner and outer cam systems, thus keeping them under "compulsory" control at all times.

These little pivoting slabs, which Colt's marketing department dubbed with such fanciful terms as "articulating" and "split-trail" locking lugs, are retained by tiny pins. They bear the load of firing, however, entirely as compression wedges by way of "knuckle-joint" recesses machined directly into the bolt body and a corresponding angled groove cut into the interior of the receiver

bridge. Both ends of each lug have an approximately .050 square-inch contact face, thus yielding very good total bearing strength for the locking system.

As it slides forward to close, the bolt unlatches; lowering the handle then draws the entire bolt assembly slowly forward. At about twenty-five degrees of turndown, just as the bolt is reaching battery position behind the breech, the inner cams on the stem of the bolt handle begin spreading the lugs. They reach full extension at about fifty degrees, remaining there through the remainder of the sixty-five degree turndown, as the bolt handle bottoms in its receiver notch.

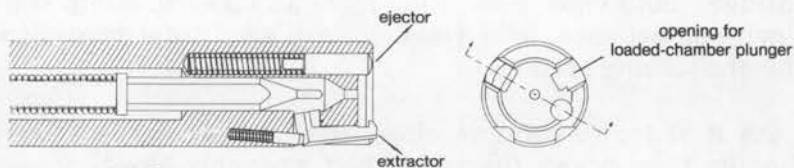
Opening the bolt initiates an opposite sequence. The outer cam ring, keyed to turn with the bolt handle, begins retracting the lugs after about fifteen degrees of bolt lift. Cam lobes within this ring engage small tails projecting back from each locking lug, drawing them perfectly flush with the outer diameter of the bolt during the next twenty-five degrees of rotation. This frees the bolt to move rearward for primary extraction during the remaining lift.

As noted in an earlier chapter, one of Paul Mauser's most important contributions to bolt action design was an absolute and infallible interlock between the locking and firing systems. His rifles couldn't fire unless they were also fully locked. The lack of such a safeguard had destroyed the reputation of some pre-Mauser rifles, and few bolt actions in the modern era have strayed far from this key Mauser principle.

The Colt Sauer does, however, and closing its bolt doesn't really guarantee that the locking lugs also spread into the receiver. To begin with, the rifle will fire perfectly well with one or more of the lugs simply removed. Perhaps more realistically, spreading of the lugs depended on a latch pivoted up from the trigger assembly to prevent rotation of the bolt body. Thus, in 1973 Sauer added a small pointed setscrew inside the receiver ring. Corresponding to one of the magazine clearance grooves underneath the bolt body, this screw point blocks the bolt from sliding forward to battery position unless it is also aligned to expand the locking lugs.

Yet the flip-out lugs obviously still don't equal the certainty of Mauser's system, where the bolt handle, cocking cam, and locking lugs are one integral piece, and so Sauer has actually tested the rifle with the lugs removed. According to Birkenhagen, it definitely remains intact, even if the bolt handle, and its receiver notch, take a severe beating.

Colt Sauer



**Colt Sauer
bolt head details**

Steel floorplate frame contains a wire spring which "ejects" the detachable magazine box when its catch in the front web of the trigger bow is pressed, nicely avoiding having to pry it loose.



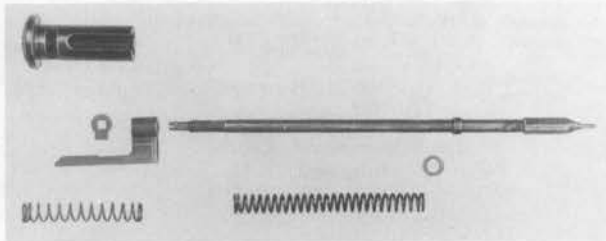
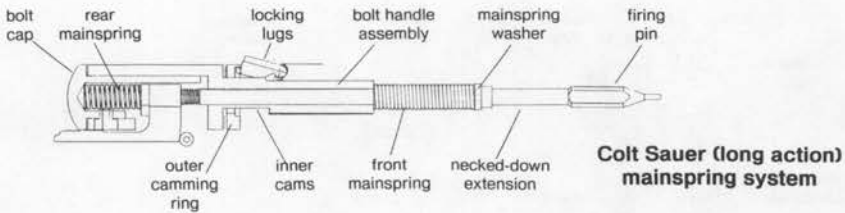
The extractor and ejector are positioned opposite each other in the bolt face, on a line running thirty degrees above the horizontal. The ejector is a spring-loaded pin, while the extractor is a small hardened steel hook anchored by its angled rear foot, and captured by a spring plunger. Its 1/16 inch-wide claw grips just under one-eighth of the cartridge rim.

Sauer chose a detachable magazine system, with a precision single-column cartridge box specially shaped to protect the bullet points. Unlike the more common double-column systems, it can't be readily charged in place. Even removed, loading isn't fast, and thus spare magazines are a particularly useful accessory with this rifle. Once loaded and inserted into the rifle, however, the single-column arrangement, combined with the lack of locking cavities in the receiver ring, offers little chance of jamming as cartridges are stripped forward.

The one-piece trigger guard and magazine frame is held at the front by a stud clamped into the split recoil lug, and at the back by a more or less conventional guard screw. While close to flush in standard calibers, the magazine protrudes down more than 5/16 inch in the magnum versions, enough to interfere with carrying the rifle at its balance point. Even deeper magazine boxes, with a capacity of one extra cartridge, are also available.

Besides the special rings which control the locking lugs, the Colt Sauer also has cams to chamber and extract cartridges, and compress the mainspring. Cocking of the mainspring and primary

Colt Sauer



Two mainsprings propel one-piece firing pin. Front mainspring fits small washer on bolt head, while the other pushes behind cocking piece. In early rifles sold, the firing pin tip was a separate part pinned in place.

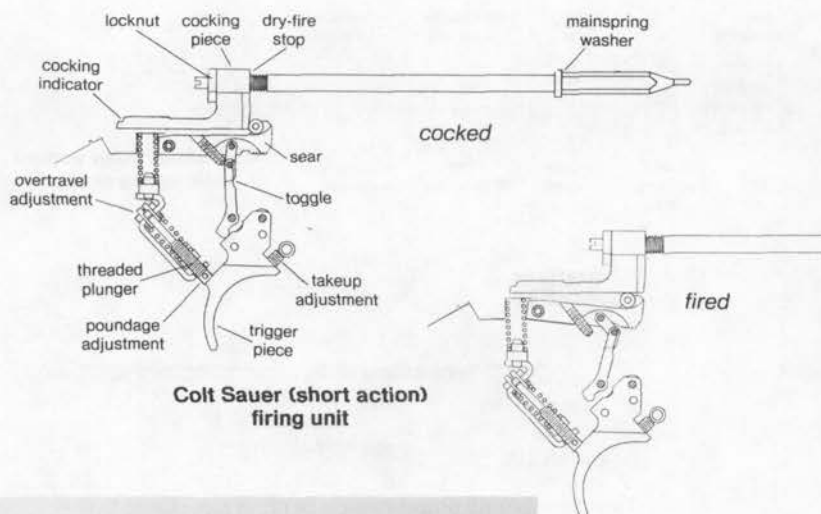
extraction of the fired cartridge are by way of entirely conventional camming arrangements. But without fixed locking lugs, the bolt handle serves as the chambering cam, an approach normally seen today only in .22 rimfire rifles. Since Sauer's locking lugs don't physically draw the bolt into breeching position, the receiver notch which controls the bolt handle is carefully milled to give it a compound movement. This first draws the bolt forward so the lugs are free to spread outward, then allows them to settle into place and take over the locking function.

The firing pin is ground from a hardened steel rod, with a small washer near the head for mainspring purchase. Threaded on the opposite end is a lightweight cocking piece, featuring a long red-painted flange to extend back under the bolt cap as a cocking indicator. A small square-holed locknut behind the cocking piece prevents any turning.

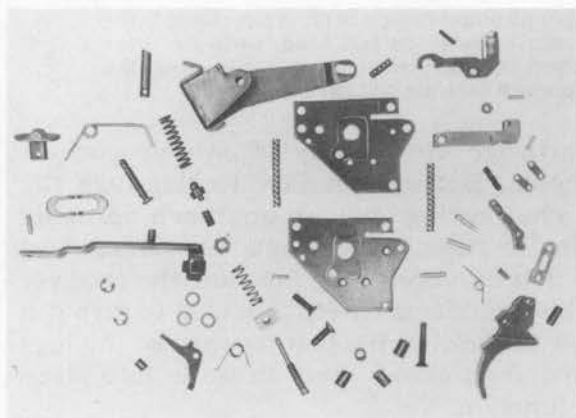
Dual springs propel the firing pin. Because a good portion of the bolt interior is occupied by the lug-actuating system, the usual front-mounted mainspring isn't quite big enough for reliable ignition, giving only about fifty inch-ounces of impact. A second spring, installed in the bolt cap to push from the rear, adds another twenty-five inch-ounces, rendering the seventy-five-inch-ounce figure given in the Summary.

Sauer's "toggle" trigger evolved from a prototype design origi-

Colt Sauer



**Colt Sauer (short action)
firing unit**



Stripped trigger assembly, which includes the safety and bolt stop, reveals enough individual parts to perhaps make up the insides of a cuckoo clock.

nally developed for the Weatherby Mark V rifle. Problems from excessive trigger friction and wear had led Weatherby engineers to experiment with a toggle mechanism in the early 1960s as a means to eliminate all sliding contact. Roy Weatherby ultimately decided that the complexity and cost of such an arrangement outweighed any functional advantages, and this pilot rifle was laid aside until Sauer resurrected the idea for its rifle project some years later.

A hardened steel roller pinned to the head of the sear starts off by minimizing friction with the cocking piece. Underneath is the toggle, consisting of a short upper link pivoted from the sear, and a longer lower link pinned to the trigger housing. These two links are pinned also to each other. A screw angled down from the sear controls the initial alignment of the toggle linkage.

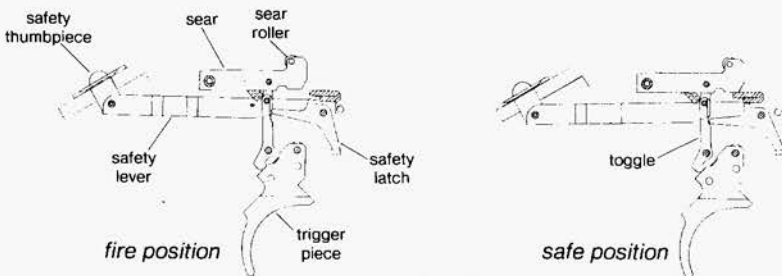
Below all this is an aluminum-alloy trigger piece, with a hardened-steel insert plate to form its pivot point and the edge which contacts the toggle. A spring-plunger assembly acts behind the trigger to urge it counterclockwise out of contact with the toggle, while a screw in its front flange limits this rotation, and thus determines the extent of initial takeup or pull.

The trigger ends up with four adjustments: initial toggle position, trigger takeup, poundage, and overtravel. The first two, governing trigger movement preceding firing, roughly correspond to the single adjustment for sear engagement in a conventional trigger. All adjustments, except overtravel, are accessible with the action in the stock.

The elimination of sliding friction, particularly that between the sear and the trigger piece, yields smooth and consistent shot-to-shot letoff. Yet the toggle has its own peculiar limitations. At true "top dead center," with all forces "neutralized" (i.e. aligned with the pins), it is extremely unstable. Sauer did explore the use of a special "inertia block" safety (U.S. Patent No. 3,707,796) to protect an unstable toggle arrangement against the normal jars and bumps associated with carrying and handling a rifle, but for the production rifles they simply stabilized the toggle by initially breaking it slightly rearward.

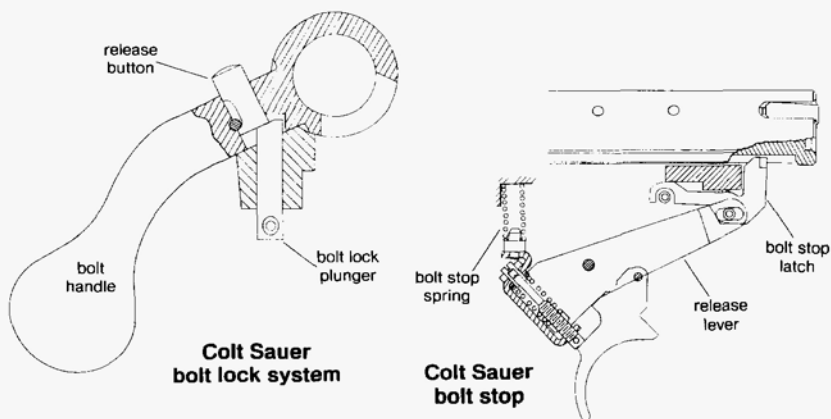
While this does render a practical "field" trigger, initial trigger pull must now bring the toggle forward to its in-line position, lifting the sear and compressing the mainspring slightly in the process. Thus, like the classic direct-draw triggers of the last century, there is little opportunity for a really light release setting.

A sliding two-position safety thumbpiece is housed in the rear tang of the receiver. Connected to a long sheet metal "safety lever," it produces a dual blocking action inside the trigger mechanism. When pulled rearward, the folded-over head of the



Colt Sauer
operation of safety

Colt Sauer



safety lever both moves underneath the sear to prevent it from dropping away from the firing pin, and trips an L-shaped safety latch to block the toggle from breaking. Pushing the thumbpiece forward removes both of these blocks. It also exposes a red warning dot painted on the receiver tang.

A patented "releasable" bolt lock system effectively adds a "third" position to this safety arrangement. Three-position safeties aren't usually too convenient to operate, and are thus seldom included in modern rifles. Use of the simpler two-position versions, however, then requires choosing between a locked-down handle (to guard against misfires) and an unlocked bolt handle (for working cartridges through the rifle while on *safe*).

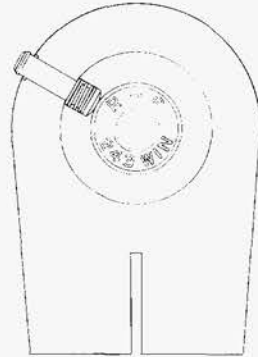
Sauer neatly sidestepped this compromise. With the safety thumbpiece slid back to *safe*, a wire spring connected to the safety lever pushes a plunger up into a hole in the bolt handle to lock it from opening. Because this plunger is positioned resiliently, however, it can be easily overridden and displaced by a "release button" housed immediately above it in the shank of the bolt handle. Thus, thumbing this button, in effect, creates a temporary *third* position, where the safety can remain engaged while the bolt is being cycled to load or unload cartridges.

The guide latch which contributes to the exceptionally smooth operation of the Sauer bolt also stops its rearward movement. In the process it can shift back far enough to seat directly against the receiver and save its pivot pin from overstress. When the trigger is pulled fully back, the latch is drawn down flush with the bore of

Colt Sauer

the receiver for bolt removal. The spring opposing this movement acts in series with the trigger spring. However, since it is much stiffer, this release system is not incompatible with an overtravel stop for the trigger. Another plus feature is a forty-five degree override bevel on the back side of the latch, which facilitates convenient bolt insertion without having to fool with the trigger.

A small "loaded chamber" plunger is fitted into the upper left wall of the receiver ring. Not to be confused with the "cocking" indicator under the bolt cap, this plunger indicates the presence of a cartridge in the chamber. Easily seen or felt, it ensures one's rifle is unchambered without having to open it. Also, that a companion's rifle is unloaded without having to ask. It also allows a quick check that a round is chambered before firing, particularly useful for those of us handicapped with an obsession to double check everything.



Colt Sauer
loaded chamber indicator

Pressed inward by a small coil spring, the plunger seats flush with the outside diameter of the receiver as long as its lower end can penetrate into the bolt face counterbore. With a cartridge in place, the plunger is forced outward, protruding about .050 inch. Useful as this simple little device obviously is, its desirability is largely offset by the relatively large opening it requires in the bolt rim walls, and the consequential loss of their ability in an emergency to shroud an expanding cartridge head.

Summary

The Colt Sauer is perhaps the most complex and unorthodox bolt action rifle to ever reach production status. In fact one could argue to what extent it should even be considered a bolt action, depending on exactly how one chooses to define that term. Some lever, pump, and even autoloading rifles which utilize turning bolts might actually have an equal or better claim to kinship with Mauser's ideas.

The "gadgetry" was not without purpose. The rifle was never intended to challenge the Remingtons or Winchesters. And in seeking a small, high-priced niche in the market, something

Colt Sauer

different was necessary. It's pretty hard to make a Model 700 enough better than Remington does to justify asking twice its selling price.

While this approach may not be unique, few have ever attempted such fundamental alterations to traditional bolt action design principles. In retrospect, the gains from many of these "innovations" don't appear to justify their cost. For example, it's hard to conclude that any extra smoothness of bolt operation resulting from the retractable lug system could outweigh the loss of reliability inherent in its vastly greater complexity.

Other features tend to fall into the same category. The trigger, while it functions well enough, simply shouldn't have to be anywhere near as intricate as it is. Nevertheless, the action has so far succeeded. Not only does Colt, despite periodic rumors to the contrary, continue to import the rifle, but Sauer has actually managed to market the action to other European arms companies for use in building their rifles.

The following summarizes the strong and weak points of the action:

Strong points:

1. Smooth working action.
2. Attractive sculptured receiver.
3. Rigid barrel-receiver makeup.
4. Loaded-chamber indicator.
5. Bolt release button.
6. Magazine ejector.
7. Sure and smooth magazine feed.
8. Convenient safety operation.

Weak points:

1. Incomplete cartridge-head encirclement.
2. Complex and intricate locking system.
3. Intricate trigger system.
4. Rear locking.
5. Magazine that cannot be top loaded.
6. Excessively deep magazine.

Colt Sauer Dimensions**OPERATING**

Extraction: set-back — .08 in.

leverage — 6 to 1

Chambering: cam-forward — .11 in.

leverage — 8 to 1

Bolt rotation — 65°

Bolt travel: short action — 3.69 in.

long action — 4.37 in.

Cock-on-opening; .325 in.

mainspring compression

proportioned as follows:

opening — .220 in.

closing — .105 in.

IGNITION

Firing pin travel: at impact — .263 in.

dry-fired — .325 in.

	short action	long action
Lock time (ms.)	2.6	2.6
Impact velocity (ft./sec.)	18.2	17.8
energy (in.-oz.)	74.4	74.5
impulse (oz.-sec.)	.68	.70

Striker/firing pin hole diameters — .064 in./ .069 in.

RECEIVER

Overall length: short action — 9.24 in.

long action — 9.94 in.

Length of loading/ejection port: short action — 2.65 in.

long action — 3.40 in.

Ring diameter — 1.295 in.

Barrel threads — M26x1.5 (metric)

Recoil-lug bearing area — .72 sq. in.

Guard screws — M6x1 (metric)

Scope-mounting screws — 6x48

Colt Sauer

BOLT

Lug bearing area — .146 sq. in.

Bolt diameter — .784 in.

Lug diameter — 1.004 in. (expanded)

Bolt face counterbore depth — .118 in.

MAGAZINE

Length: short action — 2.97 in.

long action — 3.67 in.

Capacity: .243 Winchester — 3

7mm Remington Mag. — 3

WEIGHT

	short action	long action
Receiver group	27.1oz.	28.5 oz.
Bolt group	13.7oz.	15.2 oz.
Magazine/floorplate group	10.7oz.	12.3 oz.
Total action weight	51.5oz.	56.0 oz.



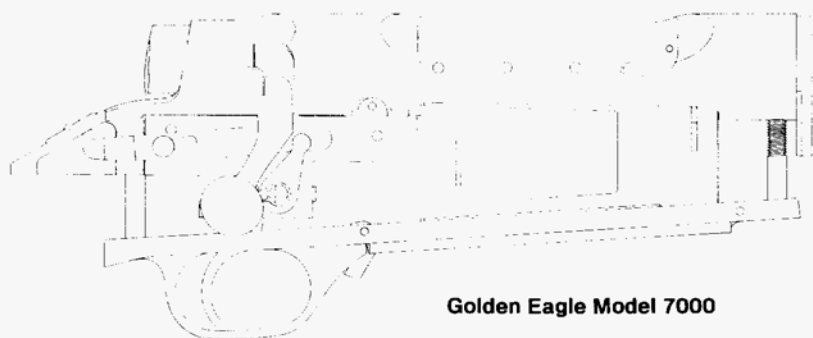
Golden Eagle Model 7000

The Model 7000 rifle was designed by Robbie Robinson. A distributor for Roy Weatherby, who during the early 1970s worked out of Texas to cover a good part of the southwestern United States, Robinson was perhaps Weatherby's all-time hottest salesman. Yet he readily left that rather lucrative position for the chance to get in on the ground floor on a new line of firearms. Teaming up with the Japanese Kanematsu-Gosho Trading Company, Robinson set up shop in Arlington Heights, Illinois, to import shotguns manufactured by Nikko of Tochigi, Japan.

Model 4000 and 5000 shotguns were marketed under the "Golden Eagle" banner, a logo which Robinson dreamed up and registered for the new enterprise. The shotguns themselves weren't entirely *new* however, being in fact just facelifted variations of the Model 101 and the Centurion and Olympian shotguns which Nikko had already been cranking out for Winchester and Weatherby for some time.

Robinson strongly felt that they also needed a high-power rifle in the line, preferably something original, if he was to sustain a successful marketing effort in this country. Since Nikko lacked experience in rifle design, Robinson being a resourceful individual took the job upon himself. His concepts of rifle design were shaped not only by his long association in using and selling the Weatherby Mark V, but perhaps equally by his admiration of the newer Colt Sauer rifle. He wanted the Colt's "sculptured" look, plus some of its other modern amenities, including the short-travel bolt and tang-mounted "shotgun" safety.

Robinson had a pretty complete set of sketches and specifications for the new rifle finished by March 1975. But instead of going directly to Japan with this package, he wanted to retain ownership of the design. Thus, he paid to have the engineering details and production drawings done for him in the United States. From these, a rough-stocked pilot rifle was made up by a tool and die



Golden Eagle Model 7000

company in Los Angeles, then tested out for strength and performance in August 1975 at a nearby rifle range. Set-up for production began very shortly thereafter at Nikko, and enough rifles had come off the assembly line by the end of the year to allow their introduction at the Chicago NSGA Show in January 1976. In all, it was a remarkably short evolution between the conception and the production of a new rifle.

Later that year, Robinson and Kanematsu-Gosho entered into negotiations with Kleinguenther's Inc. with the rather novel idea of insulating themselves against any possible future price squeeze from Nikko by establishing a second production source for the Model 7000 rifle. Highly valuing Kleinguenther's knowledge of firearms design and manufacture, they offered to set up a brand new manufacturing facility for him near San Antonio, Texas. Had the deal gone through, the Model 7000 might still be on the market today. But it didn't, and Nikko remained the sole manufacturing source.

In 1977, Fredkin Enterprises bought the marketing rights to Golden Eagle Firearms from Kanematsu-Gosho, moving Robbie Robinson and his operation to Houston, Texas. Robinson continued to import Nikko-made firearms for three more years, and a total of just under 25,000 of the Model 7000 rifles had been sold by 1980. Robinson, however, was forced to discontinue importation at that point due to the price increases from Nikko which he had earlier feared.

The Model 7000 originally sold for \$349.50 in 1976, putting it into a comfortable niche about midway between "volume" rifles like the Remington Model 700, and "premium priced" items such as the Weatherby Mark V and the Colt Sauer. But a steady rise in the price charged by Nikko was pressuring Golden Eagle. Nikko's last

Golden Eagle Model 7000

proposed price hike would have not only driven the rifle from its previous marketing position, but actually beyond the cost of the Weatherby and Colt rifles. Thus Robinson concluded that for the time being at least, the Model 7000 was no longer marketable. He discontinued its importation, along with the other Golden Eagle firearms.

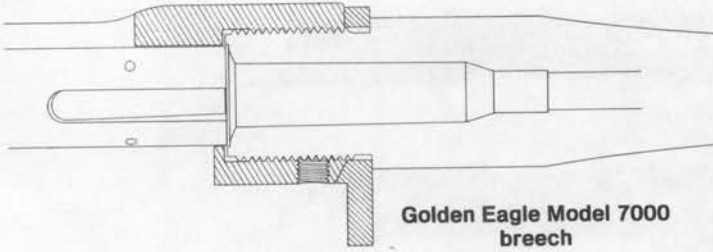
Not only were importation prices a problem, but so was the skyrocketing cost of the credit necessary to run a firearms distributorship. Fredkin consequently liquidated Golden Eagle in September 1980, selling off its inventory and other physical assets through his Gulf States Toyota subsidiary. In negotiating a settlement of his contract with Fredkin, Robinson ended up with full ownership of the paper rights to Golden Eagle. However, for the present at least, that remains an item of undefined value.

A great deal of attention was focused on "manufacturability" when Robinson's action concept was reduced to engineering drawings. A simple cylindrical receiver was well disguised beneath a sculptured exterior, achieved by plunge milling angled flats into its top and sides. A bracket plate clamped to the front by the barrel absorbs recoil, while back at the tang a separate extension block dovetails underneath to finish out the rear contour of the receiver. The bolt has three gas ports in a straight line, plus five "scalloped" locking lugs next to the bolt handle. The unique shape of these lugs cleverly simplifies internal machining of the receiver. Yet their number and arrangement fail to yield a bolt lift which is capable of efficiently powering a camming system. Inside the bolt is a multi-piece hexagonal firing pin, controlled by a large nonadjustable trigger and a two-position shotgun style sliding-button safety.

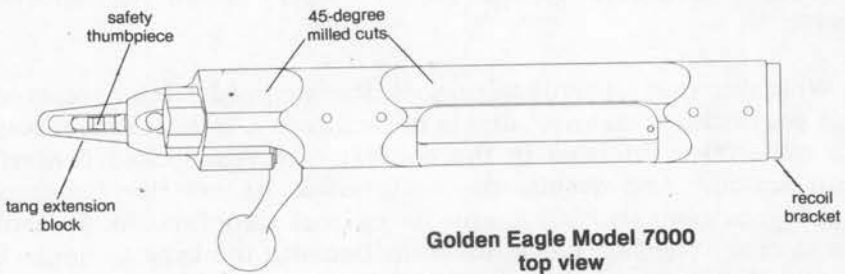
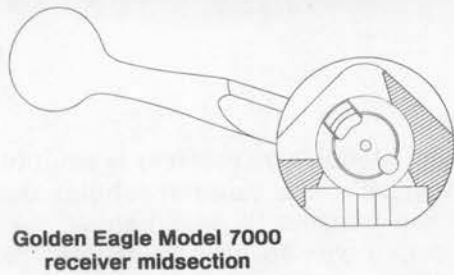
The rear location of the Model 7000's locking lugs more or less automatically rendered a shrouded breech. Close and unbroken encirclement of the bolt head essentially leaves only the extractor slot for gas escape. The lack of conventional full-length lug raceways inside the receiver would tend to then dissipate most stray gas out the loading port and the magazine opening before it could reach back into the bridge. Pressure entering the firing pin hole is vented by three Weatherby-like ports in the side of the bolt, then blocked at the rear by a shroud-type bolt sleeve.

The barrel has a small counterbore, followed by a shallow feed cone leading into the chamber. Between this cone, and a not particularly close fit-up of the barrel to the bolt, effective protrusion of the cartridge head from the chamber ends up to be slightly in excess of .180 inch.

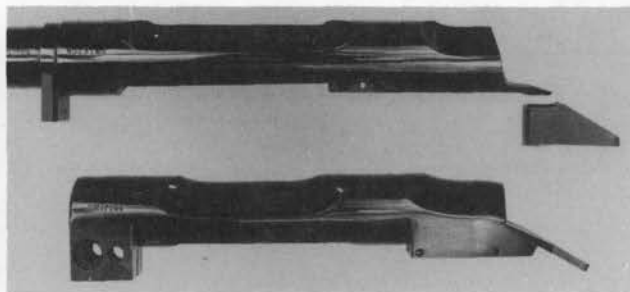
Golden Eagle Model 7000



Although Robinson owns the "Golden Eagle" trademark as applied to firearms, the logo is extremely popular, and is widely used for other goods and services in this country, even jeeps!

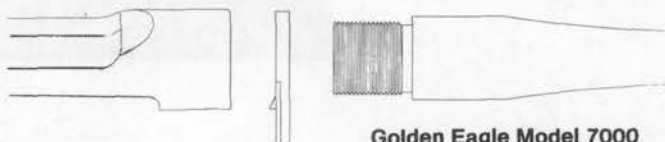


Golden Eagle Model 7000



Styling of Golden Eagle receiver (top) closely resembles that of Colt Sauer (bottom). Nikko, however, took advantage of logical production economies, including a bracket-type recoil lug and a separate mortised block at the back for the safety thumbpiece.

While the Golden Eagle's overall styling is covered by a design patent (No. 253,485), the patent marking on this receiver is erroneous, pertaining instead to a special set trigger not actually applied to the production rifles.

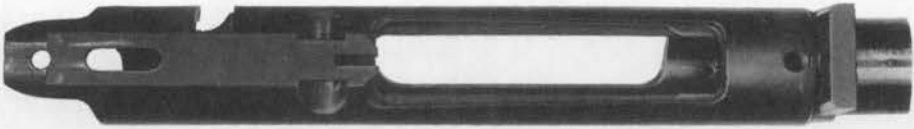


**Golden Eagle Model 7000
barrel attachment**

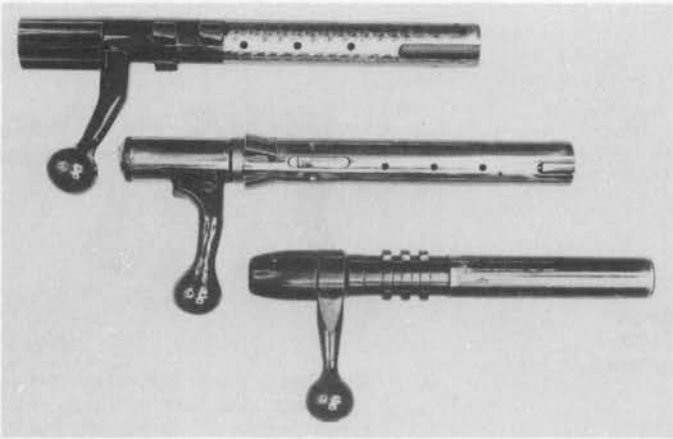
The Model 7000 receiver is sculptured on the outside like the Colt Sauer rifle. Its original tubular outline is modified by flats milled at the midsection and behind the bridge, certainly a very cost-effective way to add "character" to a plain round receiver. The resulting pattern was so successful, in fact, that Robinson obtained a patent on it (U.S. Design Patent 253,485 issued November 20, 1979).

Weighing only seventeen ounces, the stripped Nikko receiver is not particularly massive, and is in fact even a little sparse through its midsection, at least in the context of a rear-locked centerfire bolt action. And despite the sculpturing, its exterior is actually kept quite geometrically simple for ease of manufacture. An investment cast extension block dovetails beneath the tang to house the safety thumbpiece, while a plate-like recoil lug is clamped at the front by the shoulder of the barrel. On the bottom side, an

Golden Eagle Model 7000



Underside of receiver is very clean and economical from a machining standpoint, but has relatively little useful bedding surface.



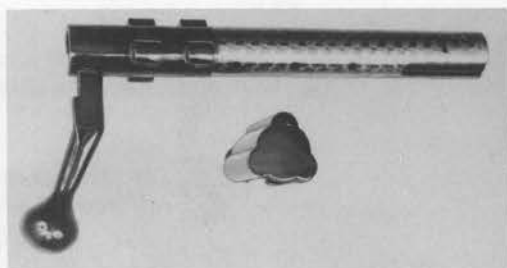
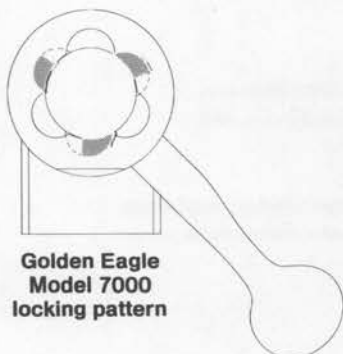
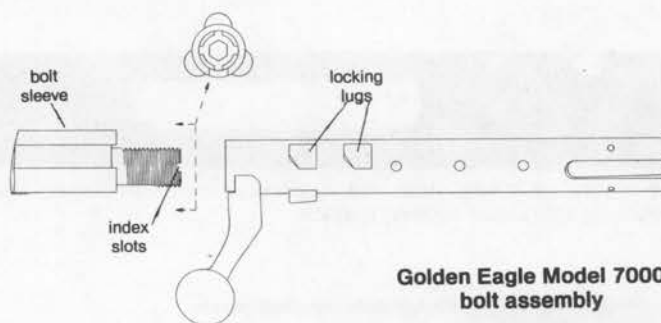
As the bolt action evolved during the last century, rear locking lugs pretty much went the way of black powder cartridges. Yet, as with black powder, recent years have seen a return of rear lugs. The Golden Eagle bolt (top) is but one of the most recent examples, which also include the Colt Sauer (middle) and Remington's 788 (bottom). No modern design or metallurgical magic, however, can avoid compression of the long bolt column created between the cartridge and these locking lugs.

unusually large trigger housing combines with the magazine to occupy a lot of space, and thus leave relatively little useful bedding area.

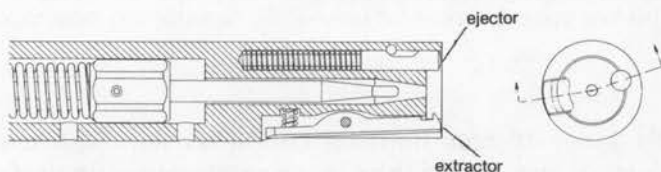
Forming the interior of the receiver was an ingeniously simple and inexpensive procedure. To start with, a .741 inch diameter bolt allowed the use of a standard series drill and reamer to cut out the basic boltway passage. Cutting the short blind raceways in the bridge was the more challenging problem. Because broaches can't be pulled completely through a rear-locked receiver, an entire set of graduated broaches would have been necessary, constituting a very slow and expensive process.

Remington's solution for the Model 788 rifle was to hammer-forged these raceways, an efficient process somewhat analogous to that used in recent years to form barrel rifling, but also requiring a

Golden Eagle Model 7000

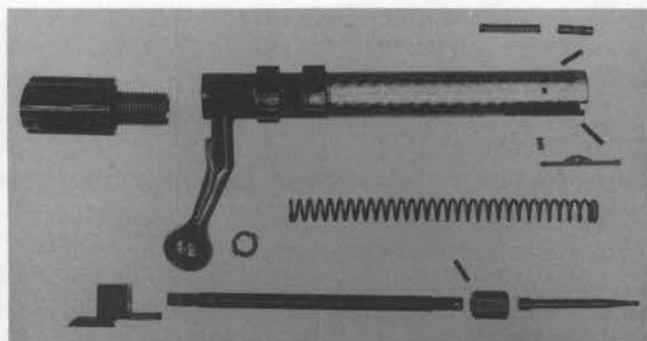


Both the bolt and bolt sleeve are cut from the same extruded steel barstock. Its three-lobed cross section allows forming the inside of the receiver without broaches. The locking lugs are sloped a little on each end to help smooth bolt movement despite any slight misalignment with the receiver raceways.



Golden Eagle Model 7000 bolt-head details

The Model 7000 bolt assembly is made up of a relatively small variety of simply formed parts.



25 26

These cloverleaf locking lugs are clustered just forward of a welded-on bolt handle. While arranged as a double array of triple lugs, one of the lugs in the forward row is omitted to make room for the bolt stop. Thus only five lugs are actually formed for locking purposes.

At the front of the bolt, the extractor and ejector fit across from each other inside the bolt face counterbore. Formed from a long narrow piece of hardened steel, the extractor is pivoted on a cross pin and actuated from behind by a small coil spring. Its six-millimeter-wide claw gets a good grip on the cartridge, covering almost one-fifth of its rim. The ejector is a simple spring-loaded plunger, held in place by a cross pin.

Golden Eagle Model 7000

rear screw passing up through the **safety** block to thread into the Model 7000's small and very shallow rear tang.

The Model 7000 has weak camming for a bolt action rifle. Length-wise displacement of the bolt both during lift and turndown of the handle is barely half of what it should ideally be to handle centerfire cartridges with ease. Leverages are also marginal. Thus, while it functions easily enough in a gun shop, on a rifle range or out in the field it is quite a different story. With a cartridge to chamber into the barrel, the bolt must literally be jammed forward before the cams even begin to engage. While this is not an uncommon problem with "multiple-lug" bolts, it is exacerbated in the Model 7000 rifle by the fact that these lugs are so far away from the breech.

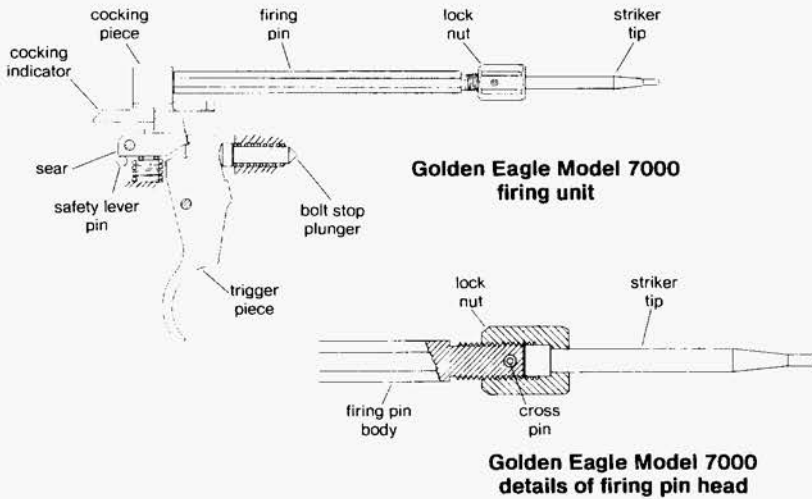
There has always been a lot of somewhat abstract disagreement about the *practical* aspects of rear locking and action stretch. Thus a simple test was run on my sample rifle, directly comparing it with a front-locked Ruger Model 77 chambered for the same cartridge (.270 Winchester). The following tabulates results when a single cartridge in each rifle was repeatedly fired, then reloaded by neck sizing only. The results more or less speak for themselves. While the Model 7000 closed easily enough on an empty chamber, it didn't do as well when even a fresh factory cartridge was introduced. Once that cartridge was fired and reloaded a couple of times, things really started going downhill. In contrast, there was little practical change with the front-locking action, regardless of how many times a cartridge was reloaded and fired.

Chamber	Bolt handle closing force (pounds)	
	Model 7000	Ruger 77
empty	3.5	1.5
new cartridge	5.5	1.5
1st reload	9.5	2.0
2nd reload	22.0	2.0
3rd reload	24.0	2.5
4th reload	31.0	2.0
5th reload	32.0	2.0

This problem can of course be alleviated by either not reloading, or at least being sure to full-length resize each time. It is, nonetheless, a potential limitation that buyers considering a rear-locked action for high-power cartridges should be aware of.

The Nikko bolt is also weak on opening. With a cam-back of only .050 inch, combined with the usual play between the extractor claw

Golden Eagle Model 7000

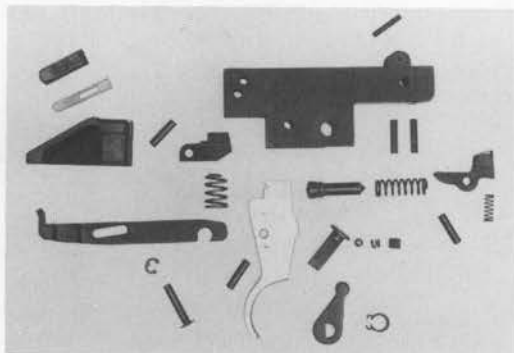


and cartridge rim, it is possible to occasionally leave a fired cartridge stuck in the chamber following bolt lift. At least twice as much cam-back would ideally be desirable, so that bolt lift not only breaks the fired cartridge case free of the chamber walls without fail, but also starts the bolt and cartridge moving back in one smooth and continuous motion.

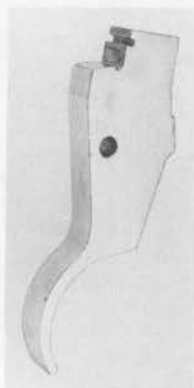
The firing pin is a four-piece assembly, built around a hex-shaped firing pin shaft cut for threads on both ends. The striker tip, a relatively small screw-machine part, is clamped at the front by means of a union-type nut. After assembly, it is cross drilled through and locked by a small roll pin. The other end of the firing pin shaft threads into the cocking piece, a small geometrically-shaped part flanged on the bottom to extend back under the bolt sleeve as a cocking indicator. A washer with a hex broached through its center fits on the shaft of the firing pin between the mainspring and cocking piece. Two tabs projecting from the periphery of this washer engage slots in the nose of the bolt sleeve to lock the firing pin against turning, yet allow unrestricted length-wise movement.

Performance of this firing pin is pretty typical of a well-designed modern bolt action. A quarter-inch striker fall combines with a mainspring preload of about twenty-three pounds to render a lock time of three milliseconds, and impact energy of a little better than seventy inch-ounces. Because the firing pin shaft and striker tip fit solidly together, there is no cushioning of the firing pin blow.

Golden Eagle Model 7000



Trigger, designed with product liability in mind, lacks any adjustments. Incorporated with it are the safety and bolt stop units. A huge gold-plated trigger piece pivots within an equally massive milled-steel housing. The safety thumbpiece slides in a special block dovetailed into the back of the receiver.



Trigger piece has a ledge precision-machined into its rear surface to support the pivoted sear.

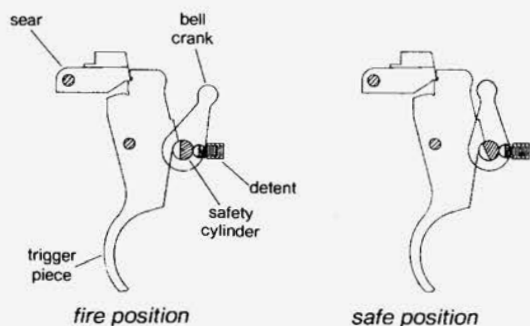
The trigger assembly features a gold-plated trigger piece. It is a heavy and bulky unit, of rudimentary design lacking any adjustments. Nonetheless, it gets the job done, thanks to smooth and wide contact and pivot surfaces, plus a geometry which directs mainspring force down through the exact center of the trigger's pivot to prevent overbalance in either direction.

A steel-block housing for the trigger tips the scales at some nine ounces, more than half the weight of the bare receiver! In Remington's Model 700, the comparable fabricated assembly adds up to 3.4 ounces, or less than one-quarter the weight of the receiver. While this may seem an inconsequential difference, in fact it represents valuable weight that could have been more profitably applied elsewhere in the Golden Eagle rifle.

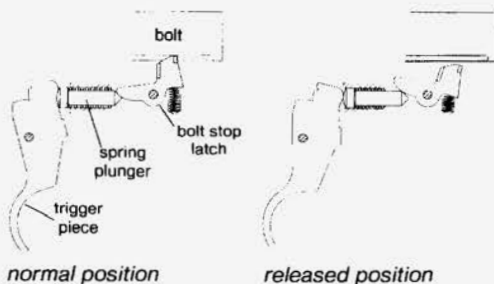
Adjustments were purposely omitted from the Model 7000 trigger, due to considerations of product liability. The amount of support engagement under the sear is permanently machined into the rear ledge of the trigger piece. It gives a pre-letoff movement, or "creep," at the trigger shoe of almost .060 inch. Poundage is likewise fixed, at about four pounds, controlled by a spring which also serves to retract the bolt-stop plunger. Finally, since overtravel of the trigger is necessary to release the bolt stop, it has more than a quarter-inch movement subsequent to firing.

A two-position safety is located in the lower front portion of the

Golden Eagle Model 7000



Golden Eagle Model 7000
operation of safety



Golden Eagle Model 7000
operation of bolt stop

trigger housing. It comprises a rotating cylinder journaled directly in front of the trigger piece, and controlled remotely by a sliding thumbpiece housed back on the extension block of the receiver. With the thumbpiece slid forward to *fire*, a long sheet metal linkage piece and a bell crank mechanism revolves the safety until a notch cut into its cylinder aligns ahead of the trigger piece to clear a path for its movement. Slid rearward, the cylinder rotates the opposite direction to block the trigger. Thumbpiece movement is convenient and quiet, and because of the generous sear engagement built into this non-adjustable trigger, the safety can also function with reasonable certainty. Engagement between the trigger piece and sear in my sample rifle was fixed at roughly .035 inch, so that even with the inevitable play or slack in the assembly, with the safety engaged, about .025 inch still remained to prevent accidental release of the firing pin.

A small metal plate, painted bright red and green, slides underneath the safety thumbpiece. When the thumbpiece is forward to *fire*, the red half shows. With the thumbpiece slid back to *safe*, only the green is exposed. There is no linkage to lock down the

Golden Eagle Model 7000

bolt handle, and thus the bolt is free at all times, even when the safety is engaged.

Despite the fact that the locking lugs protrude, their rear location prevents them from guiding the Model 7000 bolt for much of its travel. The main job of guiding thus falls to a latch which pivots up from the trigger housing to engage a groove milled into the underside of the bolt body. This latch also functions as a bolt stop. A generous slope on its rear surface allows easy insertion of the bolt, while removal requires simply pulling the trigger back to its rearward limit. The latch provides smooth and positive bolt movement. The relatively small size of the actual contact surface on its head, however, makes it somewhat vulnerable to damage if the bolt is operated roughly.

Summary

Probably efficiency of manufacture was the Model 7000's single outstanding attribute, and it was indeed ingeniously thought out from this standpoint. Forming the interior of a high powered rifle receiver with a series of standard drills and reamers is no mean accomplishment.

But as a useful firearm, it was less outstanding. It seems better suited to a display case, where a short bolt lift, weak cams, rear-lug stretch, and small bolt stop latches are not serious drawbacks, than to a rifle range or in the field under adverse conditions, providing reliable and certain performance over many years and many thousands of rounds. The following summarizes the strong and weak points of the Model 7000 action:

Strong points:

1. Attractive sculptured receiver.
2. Convenient safety operation.
3. Shrouded bolt sleeve.

Weak points:

1. Weak camming.
2. Rear locking.
3. Non-adjustable trigger.

Nikko Model 7000 Dimensions

(.270 Winchester)

OPERATING

Extraction: set-back — .05 in.
leverage — 7 to 1

Chambering: cam-forward — .06 in.
leverage — 7 to 1

Bolt rotation — 63.5°

Bolt travel — 3.89 in.

Cock-on-opening; .262 in.
mainspring compression
proportioned as follows:
opening — .291 in.
closing — -.029 in.

IGNITION

Firing pin travel: at impact — .203 in.
dry-fired — .262 in.

Lock time — 3.0 ms.

Impact velocity — 12.9 ft./sec.
energy — 71.5 in.-oz.
impulse — .93 oz.-sec.

Striker/firing pin hole diameters — .077 in./ .080 in.

RECEIVER

Overall length — 9.98 in. (10.17 in. with recoil bracket)

Length of loading/ejection port — 3.30 in.

Ring/bridge diameter — 1.353 in.

Barrel threads — M25x1.5 (metric)

Recoil-lug bearing area — .535 sq. in.

Guard screws — 1/4x28

Scope mounting screws — 6x48

Golden Eagle Model 7000

BOLT

Lug shear area — .678 sq. in.

Lug bearing area — .081 sq. in.

Bolt diameter — .741 in.

Lug diameter — 1.025 in.

Bolt-face counterbore depth — .116 in.

MAGAZINE

Length — 3.39 in.

Capacity — 5

WEIGHT

Receiver group 26.9 oz.

Bolt group 14.7 oz.

Magazine/floorplate group 10.8 oz.

Total action weight..... 52.4 oz.

Browning BBR

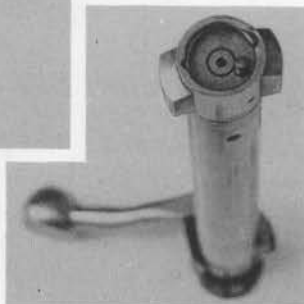


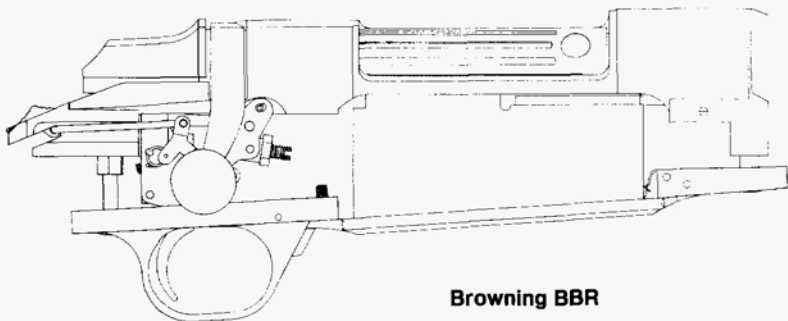
Browning, of Morgan, Utah, began marketing high-power bolt action rifles in 1959. Based on a slightly modified version of the classic and time-honored Mauser Model 98 action, these rifles were built by Fabrique Nationale of Liege, Belgium. They boasted an exceptionally high level of materials and workmanship, even in the basic *Safari* grade. In 1963 the line was expanded by the addition of rifles built in Riihimaki, Finland, on shorter-length Sako actions.

Beautiful as these rifles were, they were expensive to make. There was concern, later borne out, that they would eventually prove impractical to market. Thus, in 1967 Browning engineers began designing a replacement rifle better suited for mass production. The project was headed by Jack Lawrence and the new rifle was in large measure to be a copy of Remington's Model 700, whose basic patents had by then either run out, or were approaching the end of their terms. The idea essentially boiled down to



Browning prototype rifle, developed in 1960s to replace the Mauser-based FN design, had Remington-like bolt and receiver, and side-mounted safety. Also, swing-down magazine as later used in BBR. Bolt head (right) included Browning's version of "recessed" extractor.





Browning BBR

having FN build a nicer finished rifle selling somewhere around fifty percent above Remington's price.

From a pure engineering standpoint, it would be difficult to find a much better candidate upon which to pattern a high power rifle. After overcoming a few pesky details, like the fabrication of the little Remington-style extractors, Browning had by 1971 built and successfully tested several pilot rifles at their Utah facilities. The project ultimately ran aground, however, when FN balked at building the new rifle. Upon examining the prototypes, they informed Browning that they had no interest in retooling for an action which lacked the "tradition" and "acceptance" of their own classic design.

By this time, economic factors were pressing even harder to phase out Browning's FN and Sako-actioned rifles. Thus, in 1972 another new rifle project was launched, headed this time by Joe Badali, an engineer freshly arrived from Winchester, where he was best remembered for developing their Series 200 rimfire rifles.

By the end of that year, a design study and marketing survey was completed for this second new rifle. It recommended the following technical features:

- Sixty degree or less bolt lift. Browning had always had a lot of scope-clearance problems with the FN bolts, so this was a big concern.
- A quality appearing bolt stop. Again, Browning had taken a lot of flak for what many considered a tinny looking bolt stop on the FN actions.

Browning BBR

- A shrouded bolt sleeve. Browning wanted to avoid the susceptibility of the classic Mauser actions to gas escape from the rear of the bolt.
- Fabricated design, including a receiver-ring insert, to cut production costs to a fraction of those associated with the labor-intensive FN design.
- A front locking bolt. Despite somewhat of a trend in recent years toward rear-locking actions, Badali wanted nothing to do with any possible "dynamic" stretch problems.

Once this outline was approved by management, drawings for the new rifle were prepared and sent on to Belgium. This time FN was interested, and in late 1973 an FN-built prototype arrived back in Utah for test and evaluation. After several months of testing and showing the rifle around, Browning was quite satisfied with the results and requested FN to submit a quote for manufacture.

It seemed, however, that a new FN-built bolt rifle just wasn't in the cards for Browning. Despite working together since 1967 on making and marketing the BAR rifle, FN and Browning couldn't agree on the costs for Badali's rifle. Browning next considered Harrington and Richardson, a domestic company who was at that time actively seeking a high power bolt action rifle to market. An arrangement was proposed wherein H&R would split the tooling costs with Browning, and then manufacture the new rifle in two "styles," one to be marketed by Browning and the other for sale under the H&R logo.

Negotiations with H&R, however, also ultimately failed to yield the right kind of numbers. In early 1976, after almost two years delay, Browning finally turned to Miroku Firearms of Kochi, Japan, a company which by then was already manufacturing several firearms for the Browning product line. The FN-built prototype, plus Badali's drawings, were sent to Miroku for study. A price was soon agreed upon and Miroku shipped a pilot rifle to Browning for test and acceptance before the end of 1976. After a few months of testing, Miroku got the go ahead to tool up. Production began in summer 1977, a full ten years after Browning first started working on the idea of a new rifle and at least five years behind their original schedule.

The first shipment of Miroku-built rifles arrived in Browning's Arnold, Missouri, warehouses in December 1977, allowing the rifle

Browning BBR

to be officially introduced in January 1978 at the Houston NSGA Show. As an ironic footnote, it was also during this same general time period (1977) that FN purchased control of Browning.

Because Browning's management had figured on the new rifle much earlier, they actually found themselves with a gaping hole in their product line for almost five years. The last Safari rifles were sold in late 1974, subsequently taking on collector's status in much the same way that Winchester's original Model 70 rifles had in 1964.

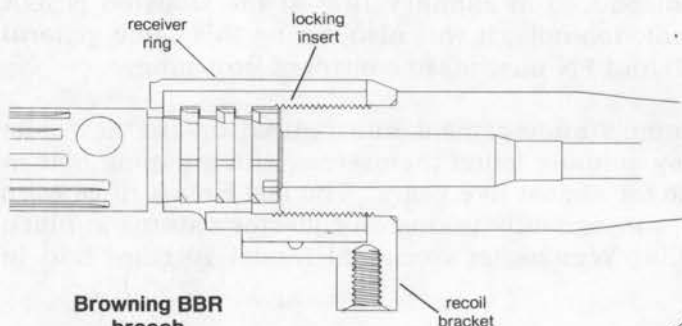
The new rifle was named the BBR (Browning Bolt Rifle), continuing a designation system Browning had applied to several of their firearms, including the BAR (Browning Automatic Rifle) and BLR (Browning Lever Rifle). Earlier plans to use the name "Safari II" were dropped due to a marketing problem in Canada. Badali had personally favored a "Lightning Bolt" logo, complete with a little gold lightning streak inlaid into the side of each receiver, to emphasize the speed of his short-lift bolt.

While Badali's drawings encompassed both short and long actions, as well as left-hand versions of each, the BBR is to date being made only in a right-handed long-receiver pattern. Two pilot rifles, exactly 3/4 inch shorter through the loading port, were delivered to Browning for test early in 1982 and their production is expected before the end of the year. Marketing plans at present, however, still do not include any serious consideration of southpaw versions.

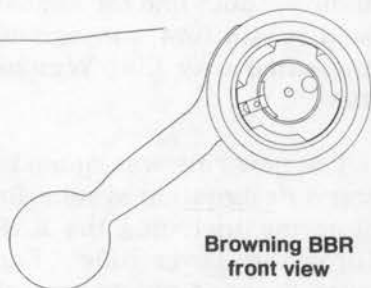
Although the BBR seems to derive many features from rifles like the Weatherby Mark V, Savage 110 and Voere K-14, in fact Badali was more influenced by Browning's own BAR, plus some of the Winchester shotguns with which he was very familiar. Badali is particularly adept in the field of tooling and manufacturing. The BBR receiver is a simple tube-like unit, made from low carbon steel. Its interior is not only free of raceways and locking seats, but even barrel threads. It combines with a large diameter bolt featuring nine little Weatherby-like locking lugs and a heavy shrouded sleeve. Not only does this bolt break down into several pieces, like that of the Savage 110, but so does the receiver. Underneath, the cartridge box mounts to the hinged floorplate, rather than the receiver directly, and contains inside a special x-shaped spring system.

The bolt locks up relatively close (.015 inch in our sample rifle) to the rear of the barrel. With a .130-inch deep bolt-face counterbore,

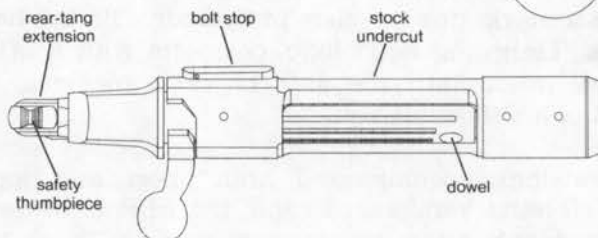
Browning BBR



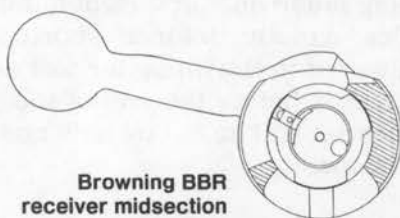
**Browning BBR
breech**



**Browning BBR
front view**



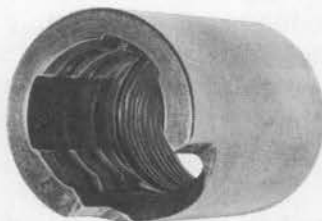
**Browning BBR
top view**



**Browning BBR
receiver midsection**



Locking insert, barrel bracket, and barrel (above), are preassembled prior to being pressed into receiver ring. Heat-treated and ground locking insert (right) contains locking seats to hold bolt, as well as threads for barrel. This leaves the AISI-1140 carbon steel receiver not only unhardened and unbroached, but even unthreaded, approaching the ultimate goal of every tooling-oriented gun designer, a pure tube.



cartridges can protrude .145 inch (.130+.015) from the barrel. Taking into account a small chamfer at the mouth of the barrel, *effective* protrusion ends up around .160 inch, still not a bad figure for a modern bolt action design.

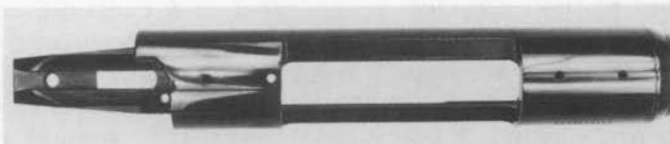
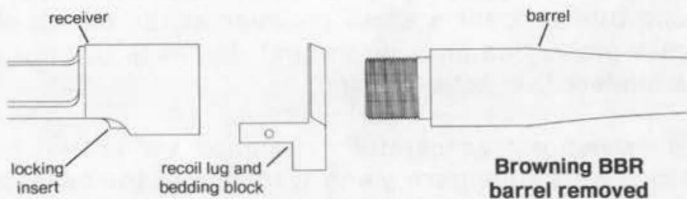
The extractor was carefully designed for breech integrity. A 3/10-inch wide claw narrows to 1/10 inch at the base, thus limiting the size of the opening in the bolt head, and also allowing actual entrapment of the extractor in the event of a ruptured cartridge. Without flutes or raceways between the bolt body and the left receiver wall, any gas escaping from the breech is not funneled to the bridge. What might reach the back of the action is stopped by a flanged and shrouded bolt sleeve. Both the receiver ring and bolt body are devoid of gas ports, which Badali considers to be mainly of marketing value.

Badali's attack on manufacturing costs fell heaviest on the receiver, rendering a daringly unorthodox construction. *Full-diameter* bolts, with their non-protruding locking lugs (perhaps best typified by the Weatherby Mark V, circa 1958), simplify the interior of a receiver to the extent that the need to broach full-length raceways is eliminated. The next logical step was taken in the early 1970s, when Voere of West Germany also eliminated the interior locking seats, by the simple expedient of clamping an alloy locking-seat insert ring behind the barrel of their K-14 sporting rifles (Chapter 14).

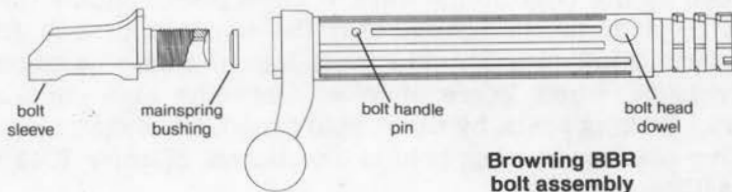
The BBR's insert ring is just another progression along that line of thought. It not only contains the locking seats, but also the threads for the barrel, and is thus simply pressed into the receiver ring as in some modern shotguns. Browning feels that this heavy heat-treated insert ring provides excellent uniformity and strength, at the same time allowing a receiver which is both simple and precise, and which can't end up warped from heat treatment.

After being hardened to between 45 and 50 Rockwell C, the insert ring is ground in a cam fixture to form three lobes on its outer diameter. These fit with several thousandths interference in the soft receiver ring, expanding it just enough to form a permanent assembly. Clamped between the barrel and insert ring is a combined recoil lug and bedding block. A "rear tang extension," bolted underneath the other end of the receiver, forms a companion bedding surface. This cylindrical receiver is thus converted to a flat bedding system by fore and aft blocks. To prevent stock contact elsewhere, the early production receivers were also undercut along the midsection.

Browning BBR



While BBR pilot rifles had four-hole scope mounting, a three-hole arrangement suitable only for one-piece bridge mounts was substituted for production. Subsequent customer complaints restored four holes (above). Because location of rear hole in bridge was by then fixed, however, standard spacing placed the fourth hole precariously near the forward edge of the bridge.

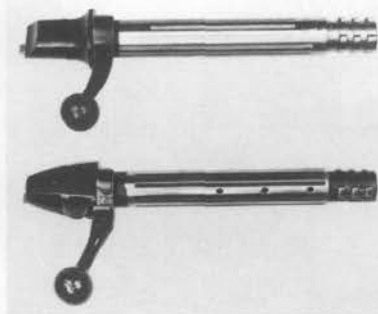


The rifle is barreled at Miroku by first indexing the locking insert and recoil bracket in a special fixture, then screwing in the barrel. This three-piece assembly is pressed as a unit into the receiver. Barrel removal obviously does not call for the reverse procedure. Once in place, the insert must remain as a permanent part of the receiver. To prevent any possibility of shifting, a special action wrench was developed to simultaneously grip both the outside walls of the receiver and the small exposed bottom segment of the locking insert.

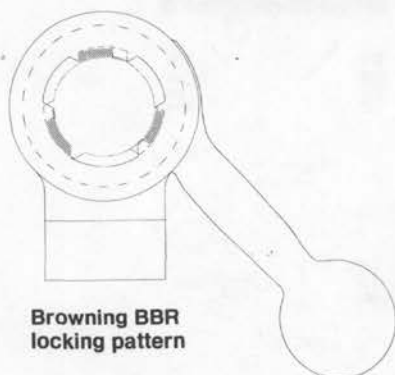
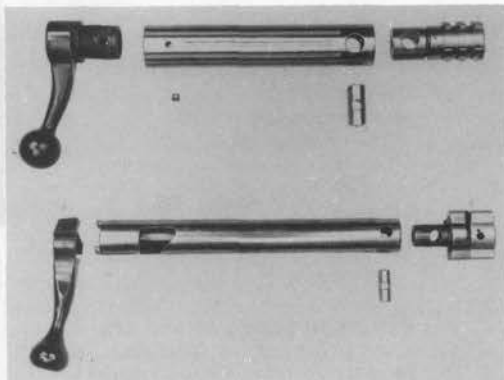
The bolt is a five-piece assembly. A large-diameter chrome-plated body, made from seamless steel tubing, has seven shallow flutes milled into its exposed side. These help tone down any appearance of massiveness, plus collect dirt which might bind in the receiver. To avoid catching or scraping the upper cartridge in the magazine, the back side of the bolt is left smooth.

A separate hardened chrome-moly alloy bolt head carries the

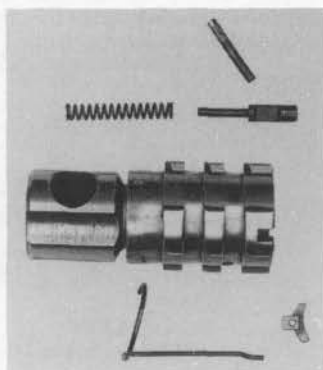
Browning BBR



While styling and size of BBR bolt favors the Weatherby Mark V (above), it is put together from separate parts like the Savage 110 (right).



**Browning BBR
locking pattern**

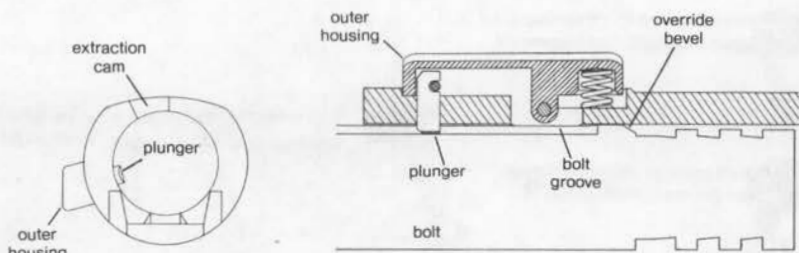


Separate BBR bolt head has extractor spring wound around groove in its base. Also housed in the bolt head is a conventional pin-type ejector.

locking lugs. It is fixed in place by a massive dowel, which is in turn drilled radially for passage of the firing pin. Cut from bar-stock blanks, the bolt head has a nine-lug locking array similar to that made famous by Roy Weatherby twenty years earlier. Three banks of lugs are evenly spaced on 120 degree centers, with each then split into three segments to triple the available bearing area. This part probably demands as much machining time as any other single part in the action, with only the possible exception of the insert ring it locks into.

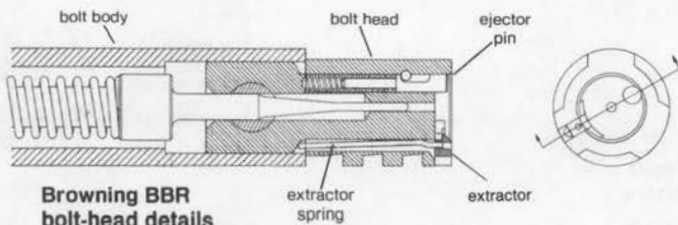
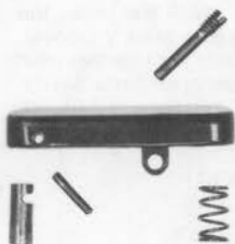
The bolt handle is an investment-cast part, knurled on its front nose to lightly engrave the soft bolt body upon assembly. A small dowel then pins the two parts together. The collar of the bolt handle is threaded inside for the rather geometrically-shaped bolt

Browning BBR

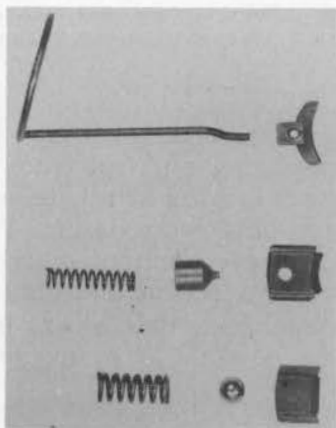


Browning BBR - bolt stop and guide

Plunger to guide bolt, and stop its rearward travel, is journaled into receiver wall and pinned loosely to outer housing. Streamlined to blend with stock, housing is attached by a threaded pivot pin, and actuated by a coil spring.



**Browning BBR
bolt-head details**



While featuring a wide claw, BBR extractor allows a relatively narrow cut in the bolt rim walls (below). It is actuated by a long wire spring which "cantilevers" it into engagement with cartridges (at left, top), as opposed to the more conventional coil spring systems operating at right angles, like the Winchester Model 70 (middle) and Savage 110 (bottom).



Browning BBR

sleeve. This part features gas-deflecting flanges in front, and a shrouded back wall broken only by a small rectangular slot for the tail of the cocking piece. The slot actually runs the full length of the bolt sleeve, allowing the preassembled firing pin unit to be inserted directly from underneath. To cover this slot, and thus provide proper circumferential support for the mainspring, a small bushing is fitted into the front nose of the bolt sleeve.

Since the locking lugs don't extend beyond the outer diameter of the bolt body, a special groove is cut along its length for guiding purposes. There is a cooperating plunger in the receiver boltway, but rather than entering vertically from the vicinity of the trigger, Badali placed it on the left wall of the receiver, in a rectangular housing intended to bear resemblance to a classic Mauser bolt stop. A close-fitting reamed hole in the receiver wall actually supports the plunger, ensuring precise control and good resistance to battering when acting as the bolt stop. Pressing the front of the housing allows bolt removal, but is not required for insertion due to bevels on the front rim of the bolt and rear of the plunger.

The extractor is the same flared-claw type found in the BAR rifle. Rather than being sprung inward by the usual arrangement of a coil spring working at right angles to the extractor, which according to Badali is too often subject to binding from even slight imperfections or tool marks on the parts, it is controlled directly by a long wire spring anchored near the base of the bolt head. Opposite in the bolt face is a pin ejector. With the bolt open, the extractor and ejector align at a thirty degree upward trajectory, ejecting spent cases just about exactly through the middle of the generous-size receiver port.

Both the trigger guard and floorplate are die-cast from a zinc-base alloy, then polished and black-chrome-plated. While this special Japanese alloy is a relatively high strength material, its weight also almost equals that of steel, and thus plans are underway to substitute a much lighter aluminum-base alloy for these parts in the future.

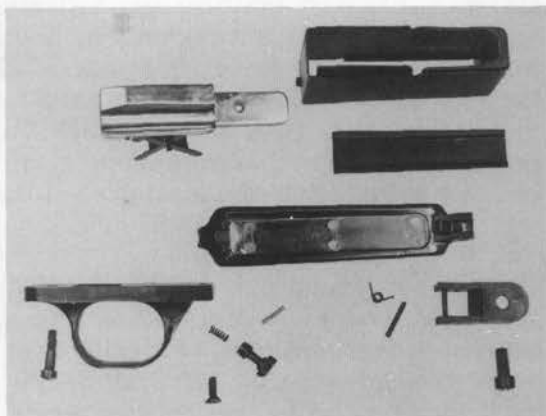
Two screws hold the trigger guard in place. Neither screw engages the receiver directly. The rear screw threads into the head of a machine bolt used to clamp the rear tang extension to the back of the receiver, while the other threads into a helicoil stock insert in front of the trigger. Up forward, under the receiver ring, a very short front guard screw supports a steel plate upon which the floorplate hinges.

Cartridges are stored in double-column arrangement in a detach-

Browning BBR



Small leaf spring ties scissors struts and follower piece together.



Feed ramp and bullet tip protector insert is riveted into magazine box. Follower, incorporating patented scissors spring, contacts only rear portion of each cartridge. The trigger guard is supported in front by a small screw which engages a helicoil insert (not shown). The first shipments of rifles lacked this screw, while an intermediate version simply used a wood screw which threaded directly into the stock.



BBR's "swing-down" magazine offers several ways to quickly load and unload cartridges. Besides access from above as a conventional "fixed box" magazine (top), it can be charged without opening the bolt by dropping the floorplate. Box is then either charged in place (left), or stripped off floorplate (right), to be loaded separately, or simply replaced with a fresh magazine.

able box. It is welded together of sheet metal, and bent over on top to form guide lips. A thick insert riveted to the front wall forms the feed ramp, with chamfered rear edges trailing back on each side to control cartridges at their shoulders, and thus protect the bullet points against recoil. The follower piece which moves up and down within this box is supported by a patented x-shaped spring

assembly (U.S. Patent 4,213, 262 issued July 22, 1980 (J.A. Badali)). Operating like a common scissors jack, it has better stability than a conventional ribbon-spring setup. The idea originated when one of Badali's bosses checked the original BBR pilot rifle out for a morning's shooting. He returned complaining of cartridges tipping and jamming in the magazine, a problem certainly not uncommon to conventional box magazines. Badali developed the scissors modification that same afternoon, inspired, he claims, by a lamp mounted out from the wall above his desk by a similar arrangement.

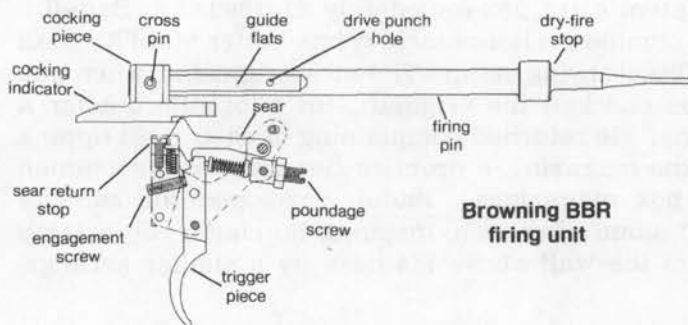
Consisting of two sheet metal struts pinned together at the middle, then tensioned by a wire spring to rotate straight, the even support provided by this arrangement helps prevent cartridges from tipping forward as they are pressed down with the thumb. Because some degree of flexibility or "give" is helpful in charging the magazine, however, a small leaf spring actually connects the scissors assembly and the follower piece.

The magazine attaches to the floorplate rather than to the receiver. This arrangement, used previously in the BAR, tends to combine some of the best attributes of both fixed box and detachable magazines. While it can be loaded and unloaded in place through the top of the receiver in perfectly conventional Mauser style, pressing the floorplate catch drops it down so it can also be loaded without disturbing a chambered cartridge.

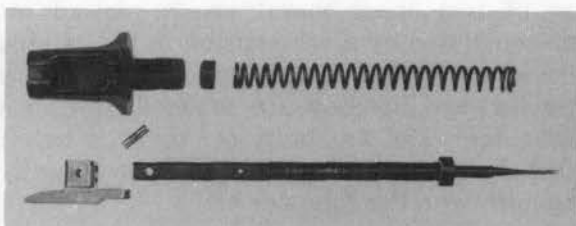
Owing to the rifle's abbreviated bolt rotation, its cam systems operate at less than peak efficiency. Because the mainspring is compressed over only sixty degrees, almost fifteen pounds of force is absorbed in lifting the bolt handle on an empty chamber. When a spent cartridge must be extracted also, the problem multiplies. The extraction cams not only have similarly weak geometry due to the low bolt lift, but the unhardened receiver generates extra friction. Going the other direction, the locking-lug cams are also too small to smoothly chamber cartridges. On closing, they pick up too late to help seat the extractor, and the bolt must thus be jossed onto the cartridge before it can even be started down into the locked position.

The BBR has a one-piece firing pin. Its tip is quite long and needle-like, but is too closely supported inside the firing pin hole to allow any bending or jamming. As in other modern actions with "shrouded" bolts, connecting the cocking piece at the other end of the firing pin is not as straightforward a proposition as it would otherwise be. By covering everything up, a shroud tends to preclude the use of a simple cross pin. Thus, parts are usually threaded together, then locked against turning, an obviously more

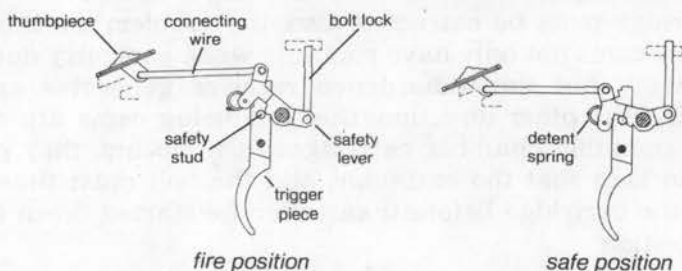
Browning BBR



**Browning BBR
firing unit**



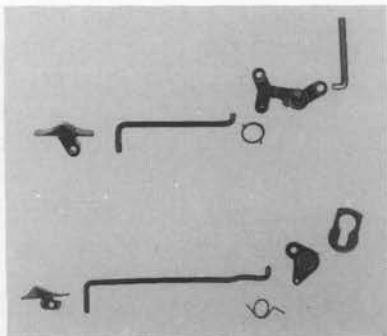
Underside of bolt shroud is slotted, and rear of firing pin milled down (top) to permit lateral assembly from underneath. Mainspring is prestressed (below) for this procedure. Mainspring flange is made thinner in current firing pin (top) than earlier version (below) as a means to ease bolt operation. Since Miroku had a large inventory of mainsprings on hand when the decision to reduce cocking forces was made, altering the machining tape for the firing pin was the most expedient solution.



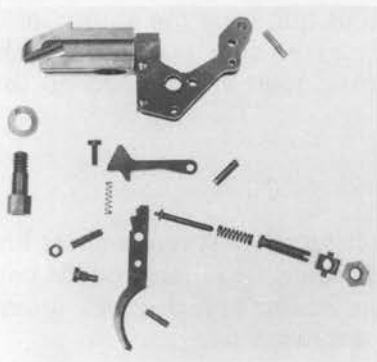
Browning BBR - operation of safety

costly procedure than simply drilling and pinning. But by milling out the underside of the bolt sleeve, plus both sides of the firing pin shaft, Badali's parts can slip into place directly from underneath. The firing pin is preassembled by trapping the mainspring forward with a drive punch, which is pulled clear only after final assembly.

Browning BBR



Basic layout for actuating two-position BBR safety (top) is similar to that of Ruger M77 (bottom), even down to the use of a loop spring to flip it into each position.



Rather peculiar trigger arrangement evolved from earlier intention to use a rolamite element at the release point. Housing is formed from two steel plates riveted to the rear tang extension. This extension block is in turn fixed under the receiver by sturdy machine screw shown.

The BBR has a two-position shotgun type safety. A tang-mounted thumbpiece is connected to a pivoted safety lever by means of a heavy bent wire. Slid back, the safety lever pivots down to make the rifle "safe" by engaging a stud threaded into the side of the trigger piece. These studs are made in various diameters, and sorted in a graduated series, so that on the assembly line at Miroku the proper stud can be chosen to account for tolerances, and ensure that at least a .020 inch overlap exists between the sear and the trigger piece on every rifle.

A second bent wire, attached to the front nose of the safety lever, rises through a hole in the receiver to lock the bolt handle when the thumbpiece is in the rearward position. When the thumbpiece is slid forward, the safety lever rotates clockwise until snapped fully over by a detent loop spring. This both clears the trigger stud, and draws the bent wire down to free the bolt handle. A red dot in the stock just behind the tang is exposed to show the rifle is ready to fire.

While somewhat unorthodox in detail, the BBR trigger is simply a rotating-sear *override* type, with the parts pivoting between two plates riveted to the rear-tang extension block. A swivel-mounted poundage spring assembly aligns itself automatically as the

Browning BBR

trigger piece rotates. This curious refinement, in an otherwise quite ordinary trigger mechanism, is a vestige of the fact that the pilot rifles used a rolamite element, which required a very long movement of the trigger piece. While this system had excellent release characteristics, Browning found it to be a bit too sensitive for field use. Subsequently, the trigger was altered only to the extent necessary to utilize a standard searing arrangement, thus ending up with, among other things, the fancy pivoting spring.

There is no adjustment to limit overtravel. Also, while a screw does exist behind the trigger piece to set engagement, it obviously can't be set below a certain point without jamming the safety lock. Thus, Browning doesn't want the factory setting tampered with, and in later rifles a rather stubborn little lock nut is used on the engagement screw.

Summary

The BBR is a typical "modern" bolt action rifle. It has a short lift, multi-lugged, bolt, streamlined appearance, and shrouded bolt sleeve. Its construction strongly favors manufacturing efficiency. All these things contribute to successful marketing.

Its ability to keep going strong after decades of hard use and even several shot-out barrels, attributes made famous by such classically rugged workhorse rifles as the M1903 Springfield and pre-'64 Winchester Model 70, is less certain. Soft cams and pressed-in locking inserts in fact lead to the conclusion that this rifle is engineered for a very finite useful life. That's not necessarily a fault of course, except in the eyes of those few diehard individuals who continue to view the bolt action by distinctly severe, if possibly outmoded, standards. In fact, anyone who "overdesigned" a rifle today using criteria appropriate half a century ago or more, would probably soon be selling insurance for a living. With exceptions like Ruger, who has embraced "traditional" standards as a basic part of his image, such things may not be seen much anymore.

The following summarizes the strong and weak points of the BBR action:

Strong points:

1. Attractive and effective bolt stop and guide.
2. Conveniently located safety thumbpiece.
3. Shrouded bolt sleeve.
4. Three-mode magazine system.

Weak points:

1. Non heat-treated receiver.
2. Trigger block safety.
3. Pressed-in locking insert.
4. Limited trigger adjustments.
5. Weak cam geometry.

Browning BBR Dimensions

OPERATING

Extraction: set-back — .08 in.
leverage — 6 to 1

Chambering: cam-forward — .06 in.
leverage — 10 to 1

Bolt rotation — 60°

Bolt travel — 4.38 in.

Cock-on-opening; .255 in.
mainspring compression
proportioned as follows:
opening — .272 in.
closing — .017 in.

IGNITION

Firing pin travel: at impact — .198 in.
dry-fired — .255 in.

Lock time — 3.1 ms.

Impact velocity — 11.7 ft./sec.
energy — 74.7 in.-oz.
impulse — 1.06 oz.-sec.

Striker/firing-pin hole diameters — .066 in./0.070 in.

Browning BBR

RECEIVER

Overall length — 9.62 in. (9.87 in. with recoil bracket)

Length of loading/ejection port — 3.25 in.

Ring diameter — 1.373 in.

Barrel threads — 15/16 - 20

Recoil-bracket bearing area — .38 sq. in.

Guard screws: front — 1/4 x 20

rear — 10 x 24

Scope-mounting screws — 6 x 48

BOLT

Lug shear area — .584 sq. in.

Lug bearing area — .121 sq. in.

Bolt diameter — .872 in.

Lug undercut diameter — .717 in.

Lug diameter — .867 in.

Bolt-face counterbore depth — .130 in.

MAGAZINE

Length — 3.37 in.

Capacity: .30-06 Springfield — 4

7mm Remington Magnum — 3

WEIGHT

Receiver group.....23.7 oz.
(w/recoil bracket)

Bolt group 18.0 oz.

Magazine/floorplate group.....9.2 oz.

Total action weight 50.9 oz.

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Below is a chapter-by-chapter summary of the patents referenced in this book. Because many of these patents have also undergone specific analysis in *Rifle* magazine (Wolfe Publishing Co.) under my "Rifle Patents" column, this tabulation includes a cross reference to the magazine.

Chapter	Patent No.	<i>Rifle</i> No.
1. Original Newton	1,215,181	75 (May 1981)
2. Savage M1920	1,177,261	71 (Sep 1980)
	1,209,872	71 (Sep 1980)
	1,306,972	71 (Sep 1980)
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3. Buffalo Newton	1,581,763	75 (May 1981)
5. Savage M110	3,005,279	70 (July 1980)
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	3,710,492	59 (Sep 1978)
6. Ranger Arms	3,274,724	74 (March 1981)
	3,330,061	72 (Nov 1980), 74 (March 1981)
9. Ruger M77	Des. 218,304	68 (March 1980)
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	3,494,216	72 (Nov 1980)
12. Carl Gustaf	3,416,253	59 (Sep 1978)
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13. Omega III	3,739,515	-----
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14. Voere K-14	2,238,120 (German)	74 (March 1981)
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